The
GEOGRAPHICAL JOURNAL

Vol LXXIX No 2 R.G.S. *February 1932*

THE BASIN OF THE RIVER PARANA: *A paper read at the Evening Meeting of the Society on 16 November 1931, by*

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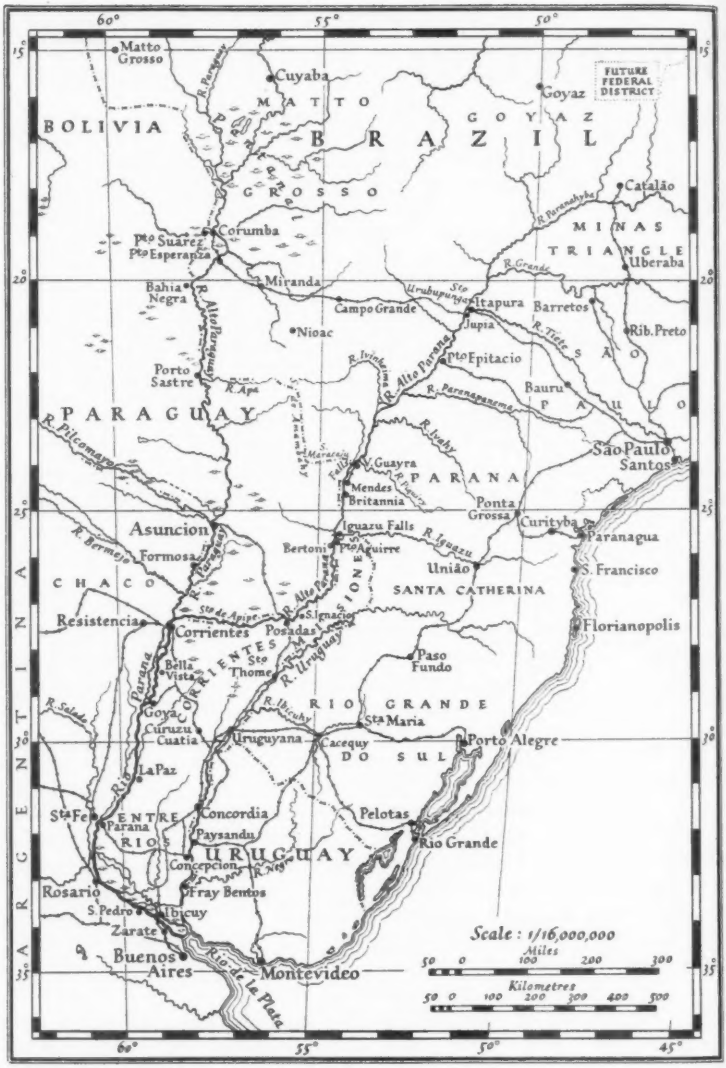
THE physical features of the Parana Basin—including the valleys of the Paraguay and of the Upper Parana rivers—have already been dealt with in other papers read before this Society. The following notes deal rather with man's activities in this region: how far he has been able to modify or overcome its primitive features and obstacles; or for the most part, since the basin is of huge extent and its population scanty, to make the most of such conditions as at present obtain.

The demand during the War for almost every kind of produce or raw material which South America could supply gave an unwonted stimulus to these hinterland areas. Moreover, exploration and general knowledge of the basin has been much assisted by the introduction in recent times of wireless telegraphy, telephony, the aeroplane, and especially of the motor car. Nothing struck me more during my recent trip from Buenos Aires to Santos, by way of the Parana Valley, than the quickened *tempo* of travel and transport. Although, in common with other backward areas of South America, the Parana Basin still remains, to quote the words of a past-President of this Society, "only partly explored, and mapped except in rare instances with vexatious inaccuracy,"* more progress has been made in the last twenty-five years than during the previous half-century. "Progress" in this sense implies that more estates have been bought and sold, more railroads built or surveyed, more highways planned (but not built save by the wear and tear of traffic), more cattle have been put to graze inside new fences which checkerboard the formerly open pampas, and more virgin forest has been burnt by more settlers in order to raise more produce at higher cost and less profit. Improved communications have also unfortunately spread epidemics of disease, such as malaria, which formerly was confined to the irrigated areas of the north-west, round Tucuman and Jujuy, but has now spread through the Chaco and, beyond all hope of eradication, to the Upper Paraguay and Upper Parana

*'Desiderata in Exploration,' Part 2, South America. By Colonel George E. Church, 1907.



Sketch-map of the Parana and Paraguay

valleys. Since the War especially, recent years have witnessed a struggle for economic life between regions whose produce, instead of proceeding by leisurely stages to market along the natural highways, now finds these highways and markets closing, or closed, and is forced to seek an outlet to the ocean by new paths or new ports.

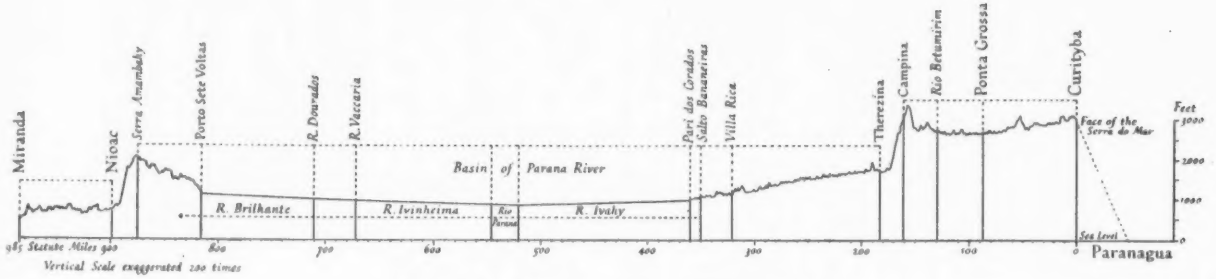
However much a traveller in the Parana Basin may wish to remain a geographical purist, political features must obtrude themselves upon his notice, for there is no river in the world which has been utilized to a greater extent as a frontier or boundary. In one or the other capacity it serves, not only the Republics of Argentina, Brazil, Paraguay, and Bolivia, but many of their Federated States or Provinces. Even where frontiers still await settlement, the part played by the River Parana, past and present, is paramount. This extensive use of the River Parana as a boundary has been much assisted by the parallelism of the Alto-Parana and Paraguay tributaries and of their sub-tributaries to the main streams over long distances. The major channels lie in the centre of a basin averaging 1000 miles wide, with tributaries extending from the Andes to the very edge of the Brazilian Plateau overlooking the Atlantic. The existence of frontiers or boundaries so easily defined has thus been of great assistance to Brazil and Argentina in delimiting their hinterland and territory, although it is only within living memory that final steps have been taken in this direction.

A mountain range makes a safe frontier; a plain makes an open frontier; but a river makes a friendly frontier. This is especially the case when, like the Parana, the river is also a main highway of traffic. At the Iguazu Falls, where the three frontiers of Brazil, Argentina, and Paraguay meet, an Argentine doctor said to me, "Although I am acting for an Argentine Commission in respect of Argentine territory only, I never ask from which bank of the river our patients come, or whether they are from upstream or downstream. Here we all belong to the river, and as neighbours we all try to help each other."

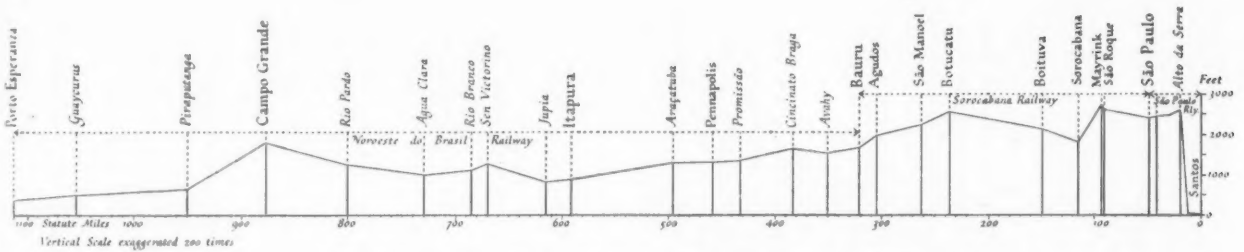
The Chaco, where the eventual frontier between Paraguay and Bolivia is still hotly disputed, has many points of special interest, but offers few inducements and many difficulties both to travel and settlement. Composed of a flat bed of sand and clay, the Chaco plain descends by very gentle levels from the Andean foothills to the banks of the Paraguay river. It is covered with forests of valuable "quebracho" hardwoods,* with palms in the flood areas, and carries a dense thorny underbrush. It is however interspersed with a considerable amount of open fertile prairie, especially near the main river, although this is liable to inundation. Seasonal droughts and heavy rains, together with a variety of insect pests, make the Chaco emphatically a backward country. One of its mitigating features is an immense profusion of bird life; in fact, Pilcomayo in native dialect means "river of birds."

The chief impetus towards a definite allotment of frontiers in the Parana Basin came as a result of the Paraguayan war, when Brazil, Argentina, and Uruguay were allied against the inland Republic, then under the despotic rule of Dictator Solaro Lopez. Assuming from the superiority of their forces the final and certain—although as events proved by no means facile—victory, the

*Besides being the largest single source of the world's tannin supply, quebracho wood is extensively used for railway sleepers and construction work.



Profile of projected route, surveyed in 1872,
across northern basin of the Rio Alto Parana



Profile along Railway between Santos and Porto Esperanza *(On Alto Paraguay River)*

Allies concluded a treaty between themselves while military operations were still going forward, known as the Triple Alliance Treaty of 1865. The eleventh and sixteenth clauses are still of interest.*

Article XI

"The present Government of Paraguay being overthrown, the allies will proceed to make the necessary arrangements with the authority constituted by them, *to ensure the free navigation of the rivers Parana and Paraguay* in such manner as the regulations or laws of that Republic shall not obstruct, hinder, nor burthen the transit and direct navigation of the merchantmen and vessels of war of the allied states proceeding to their respective territory, or territory not belonging to Paraguay, and they will take suitable guarantees for the effectiveness of these arrangements, on the basis that these regulations of fluvial police, whether they be for those two rivers, or *likewise for the river Uruguay*, shall be made by common accord between the allies and such other bordering states as shall, within the term to be agreed upon by the said allies, except the invitation made to them."

Article XVI

"In order to avoid the dissensions and wars which questions of boundaries involve, it is established that the allies shall exact from the Government of Paraguay that it ratifies definitive boundary treaties with their respective Governments upon the following bases: *The Argentine Republic shall be divided from the Republic of Paraguay by the rivers Parana and Paraguay*, until meeting the boundaries of the Empire of Brazil—these being on the right margin of the Paraguay, at the Bahia Negra. *The Empire of Brazil shall be divided from the Republic of Paraguay on the side of the Parana* by the first river below the Salto de las Siete Cahidas (the Cascade of the Seven Falls), which, according to the recent map of Manchez, is the Igurey, and from the mouth of the Igurey, and in its course upwards, until reaching its sources. *On the side of the left bank of the Paraguay* by the river Apa from its mouth to its source. In the interior from the summits of the mountain of Maracuyu—the streams on the east belonging to Brazil and those on the west to Paraguay, and drawing lines as straight as possible from the said mountain to the sources of the Apa and Igurey."

Clause XI was subsequently implemented and is to-day in force. Of Clause XVI, the portion relating to the boundary between Brazil (Matto Grosso) and Northern Paraguay was subsequently agreed by a joint boundary Commission, and a treaty was signed in Asuncion on 9 January 1872. In this treaty there are slight though important modifications of the line, provisionally agreed by the Triple Alliance Agreement, in the portion where it joins the River Parana near the Guayra Falls, which I will deal with later.

In the Paraguay Valley, Brazil took to herself a frontier which included the entire northern portion of the Paraguay river and of its affluents, from Bahia Negra, about 150 kilometres upstream from the Rio Apa, which is to-day part of Paraguay northern frontier.†

*Interesting notes on this treaty and on the conduct of the Paraguayan War are found in 'The Parana,' written in 1868, by Thos. J. Hutchinson, F.R.G.S., H.M. Consul at Rosario, Argentina. The war ended in 1870 on the death of Lopez.

†The final agreements and demarcations of the Brazilian frontier from the River Apa

If Argentina had chosen to enforce the arrangement outlined in the Triple Alliance Pact, the whole of Paraguay would have lain east of that river. Argentina however elected to fix her northern limit in the Chaco, behind the natural boundary offered by the Pilcomayo tributary, thus leaving for later settlement between Paraguay and Bolivia the intervening Chaco country on the right bank of the Paraguay river from the mouth of the Pilcomayo northwards, and much beyond the River Apa.

A series of ineffectual negotiations between the two countries in 1879, 1887, 1894, 1907, and 1923, has resulted in the present impasse, which dates from an outpost clash in 1928. Bolivia claims frontage to the Paraguay river in unbroken title held since the days of the Spanish Viceroyalty; Paraguay disputes the claim, but relies chiefly on title by right of occupation, the "uti possidetis." A recent map used by the Mihanovich Steamship Company in connection with their river service to Asuncion, Corumba, and Cuyaba (the farthest limit of navigation on the Paraguay river) shows the frontier (forces) of either country temporarily aligned by the swampy course of the River Parapiti, at an average distance of 300 kilometres from the main river, while in the north it follows roughly the cart-road from Santa Cruz town to Port Suarez (Bolivia), facing Corumba port in Brazil.

The real causes of dispute, apart from the national sentiment now involved, are fairly obvious. Paraguay wishes to increase her territorial area, which at present places her almost at the bottom of the South American nations, in addition to securing possession of potential oil lands in the Western Chaco. Bolivia has already ample territory; her need—since she has been denied her birthright of a port on the Pacific Ocean—is for an outlet for her south-eastern territory of Santa Cruz to a navigable point on the Paraguay river, and so to the Plate Estuary. In whatever way the dispute is settled however, it should be remembered that all river traffic, passenger or cargo, must pass through 742 miles of Argentine territory on both banks, *i.e.* the distance between Corrientes City and Buenos Aires Port. This basic fact makes Argentina an interested party to any final settlement, whose goodwill in the circumstances cannot be ignored.

The Parana Basin and Agriculture

In contrast to the marked changes which agriculture has brought to the areas round Buenos Aires, where 15,000,000 acres under alfalfa and over 27,000,000 acres of cereal crops have resulted in a sensible modification both of its aspect and climate, there has been comparatively little interference with the natural surface features of the country within the Parana Basin.

The limit of wheat growing within the Parana Valley ends at a line marked by the northern boundary of Entre Rios (Argentina) and may be drawn westward through northern Santa Fe, but there is reason to believe that with proper selection of seed, this limit could if necessary be extended much farther north. The extension of wheat-growing is of less importance to Argentina, which is the largest grain exporter in the world, than to Brazil, which seeks an increase in her wheat acreage, so far almost entirely confined to the Province of Rio

to Bahia Negra were only concluded in 1930, thus finalizing negotiations which had dragged over sixty years, *i.e.* since the termination of the Paraguayan War.

Las Pedras Dam on head waters of River Tiete above Santos; looking out to sea

Looking across Villa Guayra to Matto Grosso

Guest-house of the Matté Larangeira Co., Villa Guayra

Looking across Villa Guayra to Matto Grosso

Guest-house of the Matté Larangeira Co., Villa Guayra

Grande do Sul.* The recent barter of 1,275,000 bags of Brazilian surplus coffee for 25,000,000 bushels of redundant wheat held by the Federal Farm Board of the United States resulted in a temporary market loss to Argentina, which has hitherto enjoyed a monopoly of wheat supply to the Brazilian flour mills at Rio and other Atlantic ports.†

Maize is of course grown everywhere throughout South America, but after leaving the wheat-lands behind, the only other field crop of any importance in the vast area of the Chaco is the cotton planted in Argentine territory near the mouth of the Bermejo river, where 80,000 to 100,000 tons of the fibre are raised annually. Sugar cane also grows luxuriously in the Chaco, but sugar production is already in chronic excess of Argentine requirements, and is pinned by strong vested interests to the north-western provinces of Tucuman, Salta, and Jujuy. In Paraguay sugar is only grown for local requirements, the main export field crop being tobacco.

On the eastern side of Corrientes province we find, sharply marked by the course of the River Aguapey, the red-earth volcanic outlier of Misiones, which is the only portion of Argentina sharing the physical conditions and climate of Southern Brazil. In addition, the central north and south axis of the Paraguayan and Matto Grosso hills, consisting of a basalt base overlaid by massive and much-eroded sandstone, terminates in Corrientes at the low tableland of Curuzu-Cuatia. On either side of this central line we note a marked difference in the surface characteristics of the country. To the west, in the valley of the Paraguay river and its Andean affluents, we find black earth and finer natural grasses, denoting the presence of lime, in the bed of the ancient Pampean estuary, which has now moved south to the River Plate. A cross-section shows the much steeper slopes descending to the Paraguay river from the Matto Grosso tablelands, which mark its eastern boundary, compared with those draining to the Alto Parana. The valley of the latter has been cut by erosion, and its surface is lacking in lime or salty deposits. The red pastures bear a coarse grass which improves very slowly under stock and, as we shall note later, produces a different type of beef animal to the more saline "campos." This typical red soil is the famous "terra misionera" which perpetuates the name of the Jesuit Missions which first brought civilization to Guayra and thence to Paraguay and Misiones. It extends all the way to the Atlantic, and below the 1500-foot level bears a dense forest. Clearings made in this forest disclose a soil of amazing fertility which, while unsuited to live stock, has proved specially adaptable for coffee and other plantation crops.

The red-earth country, whose open pastures are everywhere thinly stocked with cattle, fixes the limit of the sheep industry. There are practically no flocks worth mentioning north of Corrientes and the black-earth belt of Rio Grande do Sul, except small flocks kept to vary the monotony of a beef diet; a

*The actual production is as follows (1928–29):

Rio Grande do Sul	142,200 metric tons
Sta. Catherina	2,000 ,, ,,
Parana	2,650 ,, ,,

†The actual tonnage is as follows:

Wheat (60 lbs. to the bushel) ..	670,000 tons
exchanged for:	
Coffee (70 kilos to the bag)	87,815 ,,

change which is the more marked since the adjacent province of Entre Rios, which spans the Parana Delta, grows the best wool in South America, being in fact the only River Plate wool which can bear comparison with the Australian product.

Even as at Corrientes the two great northern tributaries of the Parana, the Paraguay and the Upper Parana, divide in ever-widening tangent, so is it also with the products and aspects of the country they serve. Following the Paraguay to its navigable limits we see everywhere a landscape whose monotony is punctuated by only slight local variation. On the Chaco side the forest closes down in a dark fringe where the ports of call, on mudbanks whence cart tracks or light railways penetrate a few leagues into the interior, offer an unvarying export of quebracho, hides, and cattle. On the Paraguay and Matto Grosso side, passing the port of Asuncion, whence busy ferryboats ply to the mouth of the Pilcomayo, dimly visible across the muddy, island-strewn bed of the main river, we proceed by shifting channels, twisting and turning in obedience to hidden sandbanks whose vagaries only the experienced pilot knows. Passing the River Apa, limit of Paraguay, the shore-line, hitherto marked by higher banks and headlands, subsides into the low flats and flood-lands amongst which Corumba, 1863 miles from Buenos Aires, stands perched on an outlying spur of the Matto Grosso tableland. From here to Cuyaba, limit of navigation, and then only when flood waters serve, we enter fully upon the "pantanal" country, a district marked by great lagoons and swamps, where the water collected from the Plate and Amazon divide pours down into a sink, whence its drainage is impeded alike by lack of ground slope and by a hothouse growth of rushes and floating, semi-aquatic grasses. Even before reaching Corumba the quebracho forests have ceased, and other woods have small export value. The sole dependence of the whole district is now on cattle. It is true that from the fertile regions serving Santa Cruz town efforts have continually been made to maintain a connection with the Paraguay river at Port Suarez. But the 300-mile road is an impassable swamp for half the year, and for lack of an effective outlet this Bolivian area of the Parana Basin, which may in time develop, is forced to stagnation. Nevertheless, the lands lying west of the Paraguay and Lower or main Parana rivers must be regarded as the normal continuation of the Argentine pampas, and like them capable of infinite improvement under colonization and intensive pasturage. Although the low levels obtaining in the main river will always lead to flooding, yet there are millions of acres here and around the headwaters of the Paraguay that only require surface ditching to drain off quickly. This country, which includes the Bolivian lowlands around Santa Cruz, is capable of much more rapid colonization than the red earth country of the Alto Parana, owing to its suitability for live stock and the ease with which deforestation can be carried out. Further the valuable nature and homogeneity of the quebracho forest renders its disappearance only a matter of time and accessibility to transport. The valley as a whole is a great level fertile *cul-de-sac*, waiting to supplement the output of the southern pampas in its good time in obedience to the inevitable laws of supply and demand.

Let us now leave the Upper Paraguay with its quebracho logs and its long-horned kine, its caymans, herons, flamingoes, and myriad aquatic birds, its

endless vistas of sun, swamp, palm-groves, and forest, where man is overwhelmed by an abiding sense of impotence and loneliness, and return to the valleys of the Upper Parana. Here the scale of nature, if not less vast, is less impersonal, more intimate and kindly, and incomparably more beautiful.

It has been already remarked, that as soon as we touched the red-earth soil of Misiones and Paraguay, we left behind us the land of cereals, other than maize. It also marks the limit of alfalfa-growing, as understood in River Plate districts, where that unequalled forage crop has increased tenfold the capacity of the Argentine pampas. Catch-crops of alfalfa may however be grown in the river-bottoms, and forest loams even here. Cotton is grown in São Paulo (Brazil), though the main Brazilian crop centres at Pernambuco; while Paraguay has always produced tobacco, both for home consumption, where men and women are inveterate cigar smokers, and for export to Buenos Aires. But while these and a few minor crops, such as ground-nuts, castor-oil, mandioca—the accompaniment of every Brazilian meal—and every kind of garden vegetable are grown in limited quantities for local markets, the chief export dependence of the whole region is on coffee, yerba maté, and citrus fruit, the latter almost entirely confined to oranges. These we find planted across the region in patches, in the midst of a wilderness of forest and savannah, forming the woof and pattern for the cloth of colonization, whereof the older and more stable cattle industry furnishes the web. Since upon these products depends not only the progress which colonization in the Upper Parana country may make in the near future, but also the improvement of all facilities for travel and transport, they are worth a little detailed examination.

Oranges have been grown throughout Brazil ever since the days of its early occupation by the Portuguese, although the land round Bahia, whence the well-known "navel" variety was transplanted to Southern California, to be the progenitor of millions of its kind, is perhaps the most favoured district. In Paraguay also the Jesuit Fathers planted their orchards, so that to-day no house or humble rancho is without its orange "vina." Thus far neither in Paraguay nor Brazil has any disease seriously affected the orange groves, although these are usually grown with the minimum of attention. Certain blights, notably a root canker, have made their appearance, but are avoidable by grafting on the wild orange, for the tree has by now taken to the forest. Orange trees are still standing in the grounds of the ancient Indian Missions whose forbears were planted two hundred years ago.

It was from Paraguay that oranges went first to Buenos Aires, the price for export in bulk ruling at only two or three shillings per 1000. In post-war years however the Argentine Government has encouraged citrus fruit plantations in Misiones and Corrientes provinces, a task in which the railways have assisted by setting up experimental stations. As far south as Concordia, on the River Uruguay, the annual output of tangerines already reaches some 70,000 tons. The demand by Argentine growers for protection has now resulted in the curtailment of Paraguayan exports. Since Paraguayan tobacco also suffers severe imposts, in addition to a long freight to Buenos Aires, its only market, the Paraguayan grower has to rely chiefly on cattle and yerba maté to maintain a footing abroad.

As long as Argentina's population consumes all Argentina's citrus output,

nothing can be said; but if and when her growers, or those of Paraguay, venture into the rough waters of world export, they inevitably come into competition, together with other orange-exporting countries, with Brazil, the predominant partner in the Upper Parana Basin. The export of Brazilian oranges is comparatively recent, although the fruit is everywhere so plentiful as to be regarded as almost common property. The present over-production of coffee has turned the attention of Brazilian planters in Rio and São Paulo to the orange industry, and the less profitable coffee areas near the coast are being replaced by innumerable large and small orange groves. With Government aid and supervision the exports of Brazil have risen in three years to some 2,000,000 boxes during 1931. As there is probably no country in the world where the conditions of soil, climate, and refrigeration transport are more favourable than in Brazil, which has over 1000 miles of coast-line capable of growing and shipping the fruit, there seems no reason why in another decade her orange exports should not increase tenfold. Fortunately the "saturation point" of the world's consumption of oranges and other citrus fruit is yet far from being in sight, and so far the growth of the São Paulo plantations has brought only benefit to both shipper and to the European consumer.

Cattle in the Parana Basin

Cattle are not only the foundation of the livestock industry throughout the Parana Basin, but they supplement practically every other activity on the land. The highest development of the cattle business is found in the great "Frigorificos," or cold storage packing-houses, which cluster round the water front of Buenos Aires from La Plata to Zarate. They represent a combination of intimate knowledge of the industry and export markets, with a local supply of the highest-grade animal, raised on open pampa upon improved pastures, chiefly alfalfa, and bred from British stock. But from the Parana Delta northward, we come to bush country, that is, prairie land with a scattered hardwood scrub of "naudubuy," "tala," "algorobo," and finally the "quebracho" forest of the Chaco. When we get as far north as Paraguay, the grassland becomes more and more an interlude to the forest, except in areas liable to flood. This bush country marks the zone where the tick, carrier of the Texas fever parasite, is indigenous. The risk of losing pedigree animals limits here the standard of breeding that obtains farther south. In addition, cattle rearing on natural as opposed to improved pastures adds a year to the date at which the animals reach maturity, this word being used in the sense of attaining the necessary weight. Such secondary stock however attains at four years a fair size, and forms the main source of supply of the many mataderos—meat-packing houses, as distinguished from freezers—and also of the extract-of-meat factories. Nearly a dozen of these concerns are ranged along the banks of the Paraguay river as far as Asuncion, and of the Uruguay river as far as the Brazilian border.

A third and definitely inferior class of animal is bred on the red-earth land of Matto Grosso and the Upper Parana valleys. Insect pests, the worst of which are the tick and the blow-fly, make it difficult to raise any of the better breeds, while the percentage of increase in this, as in all other livestock, is also lower. The common herd here comes from a native stock known in Brazil as

Side-fall, Guayra Falls

Guayra Beach: dead side-fall

Guayra Beach: dead side-fall

the "curucu," somewhat resembling the old-time, long-horned Texas steer, crossed with the "zebu," or Indian buffalo. This zebu breed was originally imported by Portuguese settlers from Goa, India, and it is interesting to note that it is still being imported to Brazil. Although not entirely immune, the zebu suffers much less from the Texas fever tick. The headquarters of the breed are in the State of Minas Geraes, whence it has been widely adopted throughout the Parana Basin, and as far south as Rio Grande do Sul.

The marked difference between cattle bred on the improved "camps" near Buenos Aires—and this applies in a lesser degree to Uruguay also—and those bred on the pastures of the Parana Basin, is very striking. It needs no further illustration than the fact that in the River Plate well-bred animals at three years old will weigh 600 kilos on the hoof, while in Matto Grosso the "export" limit fixed for the latter, at any age between four to seven years, does not exceed 300 kilos. Thus, while the total cattle census of Brazil, in round figures 34,000,000, compares with an Argentine total of 32,000,000, a comparison made on the basis of butcher's meat rather than number would give a marked advantage to Argentina, although not necessarily in the extreme proportions quoted above.

The disparity in growth and weight of animals bred in the two countries may in some measure be due to the absence of salts, and consequently of iodine content in the Parana Valley pastures. This does not appear to be the case in the valley of the Paraguay. There are limestones in the cliff on which Corumba stands, and these are also found to the north and east, rising out of the swampy plains as isolated hillocks at Castelhos and Carandazinho. There is even a limestone cavern in the cliff bordering the river at Coimbra of considerable extent and with stalactites.* There are "salt licks" in bluffs throughout the "Pantanal" pastures of the Upper Paraguay, duplicated in many parts of the valley, where the animals eat the earth in order to obtain salt. Limestone outcrops are found also in Matto Grosso as far as Campo Grande, along the line of the railway from Corumba, and although they are neither large nor of good quality, they at least serve the local requirements. Cattle bred here, near Campo Grande, Aquidahuana, and in the "pantanal" country are much better grown than on the basin of the Upper Parana. The craving for salt is indeed characteristic of all animal life in the Upper Parana valleys. A hunter at Guayra told me that he regularly "salted" certain patches of grass land where, once tasted, the deer, tapir, cattle, and other wild things came within a very few days to lick, and could be shot, much as would be the case at a watering pool in Africa. Salt has long been recognized here as a necessity for cattle at certain seasons, and such lands are called "campos saleros," implying lands needing salt. On the height-of-land leading past the Paranahyba river, and skirting the famous cattle-breeding "triangle of Minas," is an old "salt road" leading to Corumba, where in earlier days this essential commodity was brought up the Paraguay from the River Plate.

*See "Geology of Matto Grosso," by J. W. Evans, D.SC., F.G.S., *Journal of Geological Society*, paper read 8 November 1893. Those desiring further information on the geology of Brazil may refer to "Outlines of the Geology of Brazil," by J. C. Banner, *Bulletin of the Geological Society of America*, 1919, or to the 'Geologia Historica do Brazil,' by Dr. E. P. de Oliveira, Director of Geology at Rio.

Cattle in southern Matto Grosso number about 5,000,000, and in the whole basin under review, including Brazil, Paraguay, and Argentina, there must be at least 15,000,000 more. If we take an average of 15 per cent. annual surplus only, we get a crop of 3,000,000 beef animals, which are self-transporting and available for sale at any time, at any season of the year. It must be borne in mind that the "per capita" consumption of meat in Brazil and in the River Plate countries is very high, the usual ration for peons being calculated at a kilo per day per man or woman. Large quantities of the local cattle are also made into "charque," or sun-dried meat, resembling the South African "biltong," for use in north Brazil and the Amazon valley.

Coffee

The great staple plantation crop of the Parana Basin is coffee. The plant has been so much discussed of late in connection with Brazil's present and future economic position that it needs only a very brief mention here. The lands on the left bank of the Upper Parana, between the Iguazu river and Jupia, are by every test of yield the best suited for coffee in all Brazil, and probably in the world. The average production elsewhere in Brazil is around 1250 lbs. per 1000 trees; in these hinterlands sloping to the left bank of the river the production averages 3750 lbs. per 1000 trees.

In June 1931 there was a surplus in Brazil of about 20,000,000 bags of coffee.* As the world's consumption of coffee is only 18,000,000 bags, and increases at the rate of 2 per cent. each year, and as the present annual surplus in Brazil is estimated at 4,000,000 to 6,000,000 bags, the output of Brazilian coffee in Brazil, like North American wheat or the Cuban sugar planted in Cuba, has resulted in a veritable *embarras de richesses*. The Brazilian Government now devotes an export tax of 10*s*. per bag to the purchase and destruction of stocks of inferior coffee, besides penalizing new planting. An exception has been made for the State of Parana, which at present has only 33,672,000 trees, to complete her plantations up to 50,000,000, which in most countries would in itself be considered a respectable total. But Brazil has 2,580,000,000 coffee trees and São Paulo State alone 1,180,000,000. Journeying by the Sorocabana railway to São Paulo in May 1931, our train passed for three hours through a zone of new coffee plantations about 70 kilometres wide.

The outlook for the industry thus seems to be hopelessly involved; but the Brazilian planter seems in no wise perturbed, and incidentally the visitor to the Alto Parana is offered a beverage in marked contrast to the low standards of coffee-making in England.

Yerba

"Yerba Maté," or "Paraguayan Tea," derives from a species of laurel which grows wild in the forests of Paraguay and the Upper Parana from 1200 feet to 15,000 feet above sea-level. The Jesuit Missionaries first learnt to drink it from their Guarani Indian converts, and the habit spread southward from Paraguay, till to-day yerba takes the place of tea with nearly all the working classes of Argentina and Uruguay. When the groves near the Paraguay river were worked out, the trade shifted to the Alto Parana, and Posadas (Misiones)

*A bag weighs 70 kilos.

is now its chief centre. Of late years the yerba workings in southern Matto Grosso have acquired importance. In 1930 11,000 tons were sent down the river from Villa Guayra, and the yerba from this source is reputed as being one of the best on the market. This trade is responsible not only for the excellent river service up to the limit of navigation on the lower river, but for the railway which links it with the upper river round the falls. Since the War, extensive "tame" yerba plantations have been started in Misiones territory, and these are now threatening imports of the wild yerba into Argentina, from Paraguay and Brazil. The total Argentine consumption is round 100,000 tons, of which roughly one-fifth is plantation and home grown. Brazil is in consequence endeavouring to find new markets, and it is interesting to note that last year Germany took 3000 tons and Austria 1000 tons of this new and bitter herb.

The yerba tree in growth somewhat resembles the orange or holly tree. It has a mottled grey trunk and a serrated leaf about the size of the elm-leaf, but smoother and thicker. It is claimed that drinking yerba not only corrects an ill-balanced diet, but is also a prophylactic against rheumatism. The Superintendent of the Matté Larangeira Company, which operates with some two thousand workmen in the forests, stated that although their men, mostly Paraguayans, were exposed to every kind of wet and chill in the forest and the river, they were all free from rheumatic trouble. Whether this immunity is due to the youthful resistance of the workmen and their families, to the care of their almost faultless teeth, or to their habit of passing round the hospitable maté at almost any hour of the day or night, is a matter which I must leave the medical profession to determine.

Other Products

In giving special prominence to cattle, coffee, and citrus fruits as the more important products of the Parana Basin, I have not overlooked hard woods (including cedar), tobacco, sugar, and many other tropical and sub-tropical products which can be and are actually grown. But from the view-point of colonization, forest workings are a wasting asset which necessitate a constant change of habitation; this other produce has not yet established its footing in the open market, and is therefore unreliable as a basis for permanent settlement. This does not imply that the local markets, especially those of Argentina, are not valuable. Indeed, it is to Buenos Aires that the bulk of such produce flows. But the power of absorption of such local markets is necessarily limited and, as we have noted, subject to arbitrary fiscal restrictions.

We might also, if space permitted, note the possibilities for development of produce now cultivated on a minor scale. Rice is already being grown experimentally in the Parana Delta, and if skilled cultivators could be found in sufficient number, and freight charges allowed, the flood lands along 1000 kilometres of the River Paraguay, and especially the swampy plains near Cuyaba, could produce enough rice to feed half China.

Another crop here in its infancy is silk. Mulberry trees in the Upper Parana country yield eight to fourteen crops of leaves a year, compared with two and three crops in Italy and Japan. The best land for coffee is also the best for mulberry, but cultivation of disease-free and acclimatized silkworm stock must also be considered in this connection. Silkworms are cultivated in São Paulo

State, chiefly by Japanese immigrants, and produce about 200 tons of cocoons annually, only a small fraction of the requirements of the local silk mills. As cocoon rearing is a cottage industry, and the rapid growth of the mulberry allows of intensive colonization, it would appear to be in the interests both of Brazil and Paraguay, and of consumers of raw silk, to investigate the extension of this complicated but profitable crop.

Improvement of Pastures

The greatest potential advance of any crop within the Parana Basin however lies in the improvement of its natural pastures. Tests have already been made at the Government Experimental Farms in São Paulo, Parana, and Rio States, with tropical grasses and other forage crops, the most successful of the imported grasses being known locally as "Cupini," "Para," and "Gordura." The latter has been extensively sown in the "Minas Triangle." Nevertheless, considering the vast areas of land lying within the Parana Basin as a whole, it is obvious that almost everything remains to be done. It is not practical to spend more on seed than the land is worth, nor, under present conditions, to break up the interior lands with the plough. Yet those who are sceptical with regard to the improvement of pasture on such lands would do well to recall that eighty years ago the best "camps" near Buenos Aires would support no more than three hundred scrub cattle per league, as do the "Chapadas" of Matto Grosso to-day. Indeed, the owners of the latter have this much advantage over the earlier settlers in Buenos Aires, that they are able to sell both the meat and the hides of their beasts, instead of the hides only.

It is true that the red-earth soil of the Upper Parana and the water-logged areas of the Paraguay Valley differ widely in values from the magnificent loams of Buenos Aires, while the semi-tropical climate of the central valleys will never be that of the River Plate. But the range of nature's materials is almost infinite, and when the right plant and the right stock for these lands is found, we may hope to see as great an advance as when alfalfa and wheat transformed the southern pampas.

The River Parana as a Source of Power

In attempting this survey of the productive capacity of the Parana Basin we are thinking always in terms of annual plantations or field crops, of yearly increase in cattle, or of the hard woods and timber salvaged from its forests. It has no mines, although promising indications of oil are found at the western fringe of the Chaco near the Bolivian foothills. Manufactures alongside the river are practically confined to meat-packing plants. It is true that a few local factories serve towns located at strategic points, while São Paulo on the coast is the centre of a notable industrial movement. Nevertheless, taking the basin as a whole, we can say that it possesses no single industry that does not spring from the soil. So it is not surprising that from time to time imaginative minds have studied the possibility of harnessing the water power spilled by a hundred streams, rising at 2500 to 2800 feet on the Brazilian plateau, on their way to the interior where they join the mainstream of the Parana at 300 to 500 feet above sea-level. From its wide and gently sloping valley no developments of this kind are thought possible on the Paraguay river. The falls on the Alto Parana which, from their spectacular character have received most attention, are

those at Guayra and Iguazu. The latter were reported on in detail by an Argentine Government Commission in 1920–22,* in conjunction with the rapids of the Alto Parana at Apipe near Posadas, and the Salto Grande, or Great Falls, on the Uruguay near Concordia. The broad conclusions drawn by the engineers of the Commission concerning their practical value applies to most falls in these inland valleys, and we take these as typical of many others.

Briefly, the Commission's report was adverse to the development of hydro-electric power at the points given. While these falls vary widely in appearance, nevertheless they possess certain common attributes. All three occur on frontiers. At the Apipe rapids, on the Alto Parana, the river is already 5 kilometres wide, and a dam is proposed which would make a lake 20 kilometres wide for 30 kilometres upstream. At Iguazu only the fall of water would be utilized, but on the Uruguay project a dam would again be necessary. Thus at Apipe and Uruguay the question of power is interlocked with that of improved navigation on the river. Each fall is subject to extreme flood and low water, the former reducing the height of the fall, and the latter the amount of constant power available. All three falls are isolated from any large centre of population and would require costly transmission lines to reach the consumer. (The summary printed at the end of this section gives the most important figures from the report, together with some statistics of my own for Guayra, estimated as accurately as the scanty data would allow.) Whatever its limitations for hydroelectric development, Guayra has undoubtedly the greatest potential power of any cataract in the world. Above Guayra Gorge the Alto Parana receives seven tributaries which compare in volume to the Iguazu; it receives in addition a dozen minor streams. The whole Upper Basin above Guayra, with an average rainfall of 70 inches per annum, passes through Guayra Gorge in a space of 100 to 150 yards wide, for a distance of some 12 kilometres, and falls over 200 feet in the first 3 miles.†

In the report of the Argentine Commission sufficient stress does not appear to have been laid on the possibility of damage by exceptional floods to down-stream power stations. The greatest flood on the Alto Parana within living memory occurred in June 1905; there was a further major flood in the first quarter of 1929. A difference in level of 2 metres to 6 metres in the Iguazu river above the falls will give a difference in the gorge below of 32 metres to 43 metres, but even this last figure does not cover the full effect of exceptional floods. In 1905 the Alto Parana at the mouth of the Iguazu rose 132 feet. This acted as a dam to the outflow of the Iguazu river, and in consequence the whole gorge and cauldron of the falls filled up, became flush, and overflowed to the main stream through the forest. Similarly, in the 1929 flood, I was informed by Mr. Wilson Sidwell, whose residence at Guayra for some seventeen years makes him our foremost authority, that the waters entering the gorge

*'Estudio sobre su Aprovechamiento hidro electrico de las Caidas del Iguazu, del Salto Grande del Uruguay, y de los rapidos de Apipe en el Alto Parana, por Ingenieros Gamberale y Mermoz.' Ministerio de Obras Publicas—Buenos Aires, 1928.

†The following are the unit metric equivalents:

10 cm.	= 0·39 inches	1 inch	= 2·54 cms.
1 metre	= 3·28 feet	1 foot	= 0·304 metres
1 km.	= 0·62 miles	1 yard	= 0·914 metres
		1 mile	= 1·609 kms.

from above were so backed up by the rise of the Alto Parana below that the falls practically disappeared. The gauge level at Guayra Lake shows that a rise of 10 centimetres at this point coincides with a rise of 1 metre at Port Mendes, where navigation once more begins 60 kilometres below the cataracts. The 3-metre mark was touched in 1929 at Lake Guayra, and was responsible for a rise of 30 metres (98·4 feet) 60 kilometres downstream, but within the gorge itself, at a point 4 kilometres from the head fall of the cataracts, the water rose about 40 metres (130 feet) above zero-level, so that (remarked Mr. Sidwell) if a vessel of absolute stability and *n*th horse-power had been available, it might theoretically have surmounted the 20 kilometres of the Guayra gorge and cataracts, like any other bad river rapids.

It is part of the irony of events that the major development of hydro-electric power within the basin of the Parana has come about, not by harnessing these great falls on or near the main streams, but by manipulating the remote head tributaries of the Alto Parana which rise on the verge of the Atlantic coast. The cross-sections of the Parana Basin accompanying this paper will show that the Serra do Mar, which is in fact the sea-face of the Brazilian plateau, maintains an abrupt slope of 2300 feet to the coast-flats at almost any point between Santos in São Paulo State and San Francisco port, 400 miles farther south on the coast of Santa Catherina. Throughout this distance, behind the crest of the Serra do Mar, there extends inland some 20 miles of jumbled hillocks, 50 to 500 feet high, composed of up-thrust igneous rocks pre-dating the horizontal basalt sheets found in the Alto Parana valley. The Atlantic moisture condenses in a mist that almost every afternoon in the year settles upon these hills in a thick cloud, obliterating with its level line the picturesque summits of the Serra. The rainfall on the hills behind Santos is 4 metres (156 inches) annually, *i.e.* double the precipitation in the Alto Parana valley. The Tiete, Paranapanema, and Iguazu tributaries of the Alto Parana all rise along this narrow plateau edge. The Brazil Power Company in 1925 started a project to dam back one of the head-streams of the Tiete, reversing its flow from the interior towards the coast, and creating a winding reservoir among the hills, 43 miles in length, on the verge of the Serra do Mar. With the 2300-feet drop to the plain below, this development is capable of generating up to 1,000,000 horse-power, of which barely one-tenth is actually in being, the balance being held in reserve as called for.

Such superabundant supply of power at the point of maximum utility and density of population has, together with other minor hydroelectric developments, been responsible for the rapid growth of São Paulo as an industrial centre. The population of the city has risen from 580,000 in 1920 to 1,148,000 in 1930. Hydroelectric power is at the call not only of local industry, but of the railway which actually serves Santos Port, and of any others which may be built down the Serra do Mar. Thus the Serra ramparts, running unbroken for 800 miles along the coast of Southern Brazil, may in the end prove to be an actual advantage, instead of a handicap, to traffic entering and leaving the country. In any case, man's ingenuity has provided a compensating factor which should stimulate settlement on the healthy plateaux of São Paulo and Parana States, with corresponding advantage at a later date to the interior basin of the Alto Parana.

Some estimates of the water-power available are taken from Argentine Government Reports:

At the Salto Grande, R. Uruguay, the discharge at lower water is 250 cm./sec. and at high water 30,000, with available fall 16 m. The corresponding H.P. is estimated at 100,000 to 200,000, and the cost of power station and transmission line 540 km. to Buenos Aires is estimated at 177 million Argentine pesos.

The corresponding figures for other sites are:

Iguazu Falls: 300 to 4750 cm./sec.; 72-m. fall; H.P. 180,000 to 1,200,000; to produce and transmit 250,000 H.P. 1200 km. would cost 200 million pesos.

Rapids of Apipe, R. Alto Parana: 5400 to 60,000 cm./sec.; 14-m. fall; 1,200,000 to 7,000,000 H.P.; 415,000 transmitted 1000 km. would require 350 million pesos.

Guayra Falls: Volume perhaps 5000 to 50,000 cm./sec., with fall 65 m., and H.P. 4 to 25 millions. About 1300 km. to Buenos Aires or São Paulo.

The cost of current produced from coal at the power station of the Cia. Hispano-Americana de Electricidad at the New Port in Buenos Aires was in 1921 0·0306 pesos per kilowatt hour, which is somewhat less than the estimated cost on any of the hydroelectric schemes.

Travel on the River Parana

It will be noted that only in a few stretches is the Parana river paralleled by railroads or even roads. To do so would entail costly bridge work over the wide mouths of tributary streams; moreover, the river itself is a competitor for traffic. Thus the general tendency of land transport throughout the Parana Basin is to keep away from the main streams while accompanying their general northerly direction upon the flat divide or tableland that usually obtains between them.* Throughout the lower reaches of the Parana there is a large, if unostentatious, traffic which uses its side streams and backwaters, as well as the main channels. After passing railhead at Asuncion in Paraguay, or Posadas on the Alto Parana, all traffic comes perforce to the river. Under the extreme shoal conditions of the Paraguay between Corumba and Cuyaba, or in the Alto Parana tributaries above Guayra, the draft of vessels is limited to 20 inches. Much praise is due to up-river owners and pilots who succeed at these distant points in maintaining on the whole an efficient service, despite the lack of the usual aids to navigation.

Travel on the Upper Paraguay is limited to satisfying the requirements of the minor ports or settlements alternately on the Brazilian or Chaco side of the river. There is also a certain traffic with Bolivia, *via* Port Suarez and Santa Cruz. But north of Cuyaba, in the region rising to the central water-parting of the continent, there are few attractions save for the naturalist or explorer, and no organized facilities of any kind for travellers.

It may not be out of place here to suggest a project which would not only stimulate interest in these regions, but be of permanent value to the world in years to come. I refer to the formation of a National Park on the head-waters of the Paraguay. There are hundreds of square leagues in this region of little

*The strategic railway cutting across the watershed from Bauru (São Paulo) to Corumba is a notable exception. This railway has, moreover, built the first and only bridge over the Parana river, 1000 metres long. The crossing is made at Jupia, 2618 kilometres by river from Buenos Aires and 782 kilometres by rail from Santos Port.

present commercial value, covering swamps, forests, partially flooded areas, and, finally, the higher land rising to the Plate–Amazon divide, where both the flora and fauna are of great interest. The problem of preserving wild life before the approach of man has lately been dealt with by an abler pen than mine.* In North America the provision of National Parks is considered not only a public duty, but of definite economic value. Thus far, no attention has been given to this important matter anywhere in South America. The subject is too wide to warrant more than passing reference to it here, but if placed before the proper quarters there is little doubt that the public spirit, already so much in evidence in the various South American States in their provision for municipal amenities, would ensure a favourable consideration of the project for National Parks.

If the Paraguay river finally leads us to no one and nowhere in particular, it is very different when at Corrientes we pass into the Alto Parana. Up to Corrientes navigation is feasible at most seasons for boats of 10-feet draft. The Argentine Government has set itself the task of dredging a permanent channel between Rosario and Corrientes, to obtain an all-the-year-round depth of 10 feet, but this is not yet accomplished. The Apipe rapids between Corrientes and Posadas limits navigation to 2½-feet draft in low river, necessitating at such times a change of steamer. Posadas is the focusing point of all Alto Parana travel and traffic, and from here to the limit of navigation at Port Mendes 10 feet is obtainable. Generally speaking, the draft of vessels on this section is subordinate to their speed, since river currents run from 5 to 8 knots an hour during flood season.

The journey to Posadas from Buenos Aires can be made by three routes: (1) by steamer up the Parana *via* Corrientes, occupying 72 hours; (2) by railroad, the trains crossing the Parana Delta by ferryboat to Entre Rios, in 24 hours; or (3) if a combined rail and river route is desired, by steamer up the Uruguay to Concordia and thence by train to Posadas in 36 hours. In every case excellent sleeping and restaurant accommodation is provided both on boat and train. This latter route formed the first section of my return journey from Buenos Aires to Santos. From Posadas we followed the course of the Alto Parana river; a stop was made at Iguazu, thence to Guayra and 360 kilometres beyond to Epitacio, the small river port which is the terminal on the Alto Parana of the Sorrocabana railway, and so to São Paulo. Considering the natural beauty and interest of this inland river, and the ample facilities for using it, the prevailing ignorance on the subject in Buenos Aires and Rio is remarkable. My resolve to take the river route, instead of the usual ocean steamer from Buenos Aires to Rio, was prompted by the desire to prove that it was to-day not only practicable for ordinary travellers, but had unique attractions that must in time assist in opening up these neglected hinterlands.

The following scale of distances, etc., on the Parana river system has already appeared in a former paper,† and is now revised. It serves to show the great extent of these waterways, many of which are now open to travel under modern conditions.

*See "Proposed British National Parks for Africa," by Major R. W. G. Hingston, *G. J.*, vol. 77, 1931, pp. 401–428.

†"The River Parana," by W. S. Barclay, *G. J.*, vol. 33, 1909, pp. 1–40.

		Distance in miles from Buenos Aires	†*Zero level of river in feet above mean water-level at the Boca, Buenos Aires*
River Plate Estuary	Buenos Aires (the Boca) ..	*0	*0·00
	Boca del Guazu (Delta) ..	*76	*1·4
River Parana	San Pedro	*174	*4·9
	Rosario (Paso Alvear) ..	*252	—
	Parana town (Bajada Grande)	*368	*30·2
	Corrientes	*742	*137·0
River Paraguay	R. Bermejo (mouth) ..	811	—
	Formosa	900	—
	R. Pilcomayo (mouth) ..	1003	—
	Asuncion	1017	203·0
	V. Rosario	1136	—
	V. Concepcion	1276	—
	Porto Sastre (R. Apa) ..	1458	—
	Bahia Negra	1690	—
	Esperanza	1746	349
	Corumba	1862	372
	Cuyaba	*approx.* 2300	—
River Alto Parana	Corrientes	*742	*137·0
	Posadas	984	230·0
	R. Iguazu (Porto Aguirre)	1197	321
	Porto Mendes (limit of navigation below Guayra) ..	1287	367
	Lake Guayra (above Falls)	1323	728
	R. Ivahy (mouth)	1393	754
	R. Paranapanema (mouth)	1473	787
	Epitacio	1547	853
	Jupia	1640	883
	R. Tiete (mouth)	1650	*889
	Urubupunga Falls (below)	1653	*898
	,, ,, (above)	1706	*938
	R. Grande (Confluencia Paranahyba)	1713	*986

*Taken from official figures of Brazilian and Argentine Surveys.
†Zero level is assumed to be the lowest recorded flow at the given point.

(*To be continued*)

DISTRIBUTION OF THE URBAN POPULATION IN GREAT BRITAIN, 1931: *A paper read at the Afternoon Meeting of the Society on 7 December 1931, by*

PROFESSOR C. B. FAWCETT, D.SC.

IT is now a commonplace observation among students of urban growth that the census figures often give a quite inadequate measure of the relative size and importance of the larger centres of population in this country because they are limited to areas defined by local government boundaries.* Some few students have attempted to improve on these figures by adding together the populations of towns which appeared to them to be in fact so closely grouped as to form one urban region.† A comparison of some of these groupings with the actual facts of urban distribution seen in the course of journeys to and about the principal urban areas of this country has convinced me that attempts to estimate the population of such groups from census figures and small-scale maps alone are of very little value. A reliable grouping of census "towns" for the purpose of calculating the real extent and population of any large urban area can be made only on the basis of acquaintance with the area and a careful study of large-scale maps. For the larger urban regions of Great Britain the writer began this study some twelve years ago; and a first statement of the results was published after the census of 1921.‡ This paper is based on a much fuller acquaintance with many of these areas and on studies of the O.S. maps and the census reports.

In studying such large urban areas it is convenient to have a definite name for them, and the word "conurbation" has been adopted. This term was, I believe, first coined by Professor P. Geddes some twenty years ago; and it has been used very widely, though often with a somewhat loose connotation. Here, and in previous papers, I use it in the strict sense of a continuously urban area: *i.e.* a conurbation is an area occupied by a continuous series of dwellings, factories, and other buildings, harbour and docks, urban parks and playing fields, etc., which are not separated from each other by rural land; though in many cases in this country such an urban area includes enclaves of rural land which is still in agricultural occupation. In Great Britain the larger of these conurbations have usually been formed by the growth and expansion of a number of neighbouring towns, which have spread out towards each other until they have reached practical coalescence. This outspreading of the towns has been greatly accelerated within recent decades by the effects of motor transport and many new roads. In each of our large conurbations there are several urban centres; but in most cases one of these is so far dominant that

*In recent censuses of the U.S.A. there are statements of the populations of some "metropolitan regions"; the New Zealand census distinguishes "urban areas," including the four largest cities; and the French census distinguishes, in some areas, between "population agglomerée" and "population dispersée."

†*E.g.* P. Geddes, in his 'Cities in Evolution,' 1915; S. S. Visher, "Chief Urban Centers of the World," in the *Journal of Geography*, September 1929; and compare M. Jefferson's "Great Cities of the United States," in the *Geographical Review*, July 1921.

‡"British Conurbations in 1921," in the *Sociological Review*, April 1922.

the whole may be named from it and spoken of as, say, "Greater Manchester," or "Greater Birmingham." More rarely two or more of the included cities may be of nearly equal importance, as is the case with Leeds and Bradford.

An observer in an airship hovering above one of these conurbations on a clear dark evening, when all its lamps are lit, would see beneath him a large area covered by a continuous network of lights, glowing here and there in brighter patches where the main roads meet in its nodal shopping districts and elsewhere shading into the darker patches of its less fully urbanized areas—parks, water surfaces, or enclaves of rural land. To such an observer the continuity of the conurbation would be the most salient fact about it. If he were high above the Pennines between Leeds and Manchester he could see at least four such great conurbations. Near him to the north-east is the one formed by the confluent industrial towns of West Yorkshire; westward he would see the still larger one which is focused on Manchester, and beyond it the lights of the seaport on Merseyside; while to the south-east lies Sheffield. If he were at a sufficient height he might be able to see the haze of light over Birmingham, 75 miles to the south, and over Tyneside, 90 miles away to the north. Amongst and around the nearer conurbations he would see the many smaller scattered patches of light which mark the lesser towns. And it would be easy to imagine an outspreading of all these towards coalescence in one vast urban region covering the whole of this industrialized central area of Great Britain.

It is often difficult to determine the precise point at which the growth of two or more neighbouring towns towards each other has so far filled up, or "urbanized," the area between them as to justify us in regarding them as geographically continuous, and therefore as parts of one conurbation. Where there is no break in the continuity of houses and streets across a long common boundary, as from Manchester to Salford, there can be no doubt; where the division is marked only by a harbour or river, which is in fact a link rather than an area of separation, as between Liverpool and Birkenhead or Nottingham and West Bridgford, there is equally no doubt as to the actual unity. Cases in which the unity is less definite occur elsewhere; some of these will be referred to later.

When the census populations are so grouped as to treat each of our large continuous urban aggregates as a single unit it becomes evident that we have in Great Britain no less than seven such conurbations each of which contains more than a million people. There are also thirty others with more than 100,000 inhabitants each. All these are listed, in the order of their 1931 populations, in Appendix I (p. 109), and their distribution is shown on the accompanying map (Fig. 1). In Appendix I an asterisk marks a conurbation which consists of four or more separate urban districts; these are listed separately in Appendix II (p. 111). Where more than three separate districts are included the names are given in Appendix I, and the population is that of the whole.

LONDON: The population of Greater London used in this paper is that given in the Census Report. The area actually occupied by continuous town, the London conurbation, extends in several places beyond that of the City of London and Metropolitan Police Districts, which together form the Greater London of the Census. The addition of the contiguous urban areas

brings the population up to 9,150,000. There are also many near, though non-contiguous, urban areas which are economically part of the metropolis. And

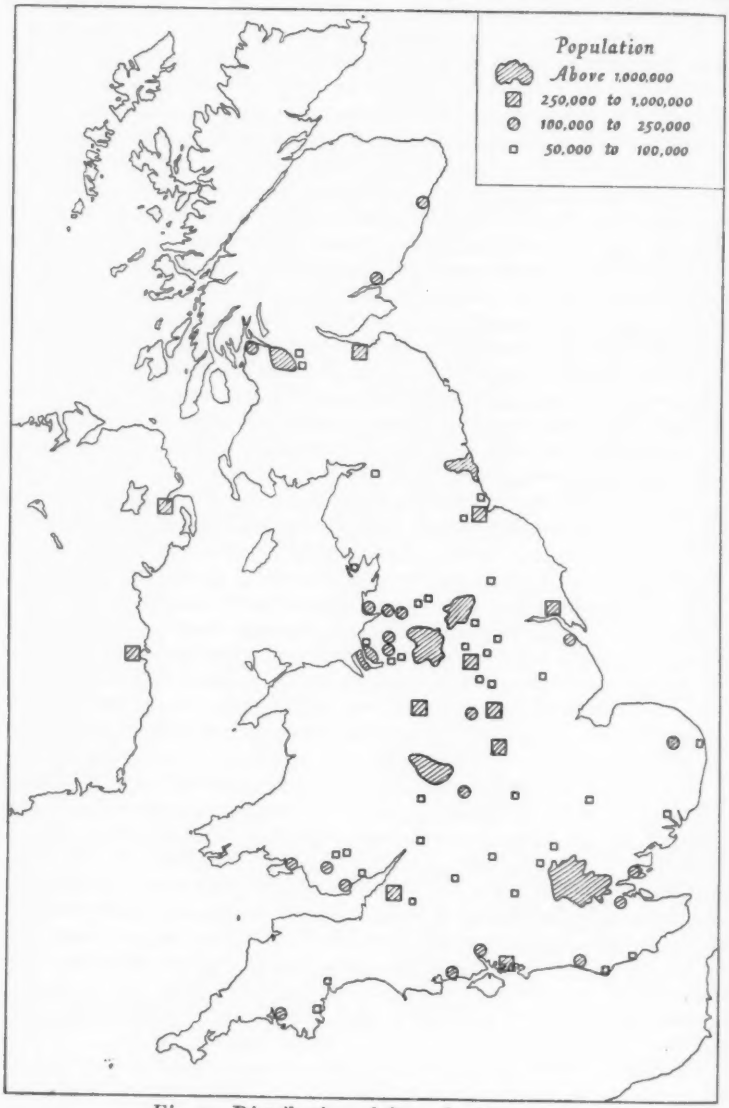


Fig. 1. Distribution of Conurbations, 1931

the total population of that urban region may fairly be estimated at about 10,000,000.

MANCHESTER: The continuously urban area of which the City of Manchester is the focus consists of two distinct parts. There is an Inner City formed by Manchester and Salford, with six smaller urban districts grouped closely round them, which is a very compact urban area containing more than 1,000,000 inhabitants. Round this, at a distance of from 8 to 12 miles from the central point marked by Manchester Town Hall, is what may be called the Manchester Ring. This is a series of urban districts, five of which are county boroughs, which occupies a band of territory curving round Manchester in the form of a horseshoe with its opening to the westward. Each of the principal segments of the Ring is connected with the central city area by a band of town; these bands radiate like the spokes of an irregular wheel from Manchester to Bolton, Bury, Rochdale, Oldham, Stockport, Altrincham, and other places. The total population of the Ring is somewhat greater than that of the Inner City.

The Manchester conurbation occupies the upper valley of the River Mersey, together with those of its chief tributary, the Irwell, and several smaller streams. The area is a north-eastward bay of the Lowland, with a rim of highland extending round it from north-west to south-east for a little more than a semicircle. The valleys of the streams which flow inward from its broken rim of high ground converge towards a common focus near the centre of Manchester-Salford. Here is the chief node of its routes; and if the area were agricultural this would be the site of its chief market. The industrial developments of the last two centuries have concentrated within this small area a population of nearly 2,500,000, clearly marked off from the neighbouring West Yorkshire and North Lancashire towns by the highlands of the southern Pennines and Rossendale Forest. There are many patches of open land within this conurbation which offer opportunities for the maintenance of open spaces, and for the loosening out of its overcrowded areas.

BIRMINGHAM: The third of our great conurbations is that of the district which is often called "The Black Country." It occupies an irregular area on, and near to, the coalfield of South Staffordshire. The City of Birmingham contains more than half the total urban population; and, though it is not central in the conurbation, the whole is clearly focused on that city. This is, I believe, unique among very large cities in that it is not in any valley or on the shore of any sea or lake. It is actually astride the main water-parting of Great Britain, on the divide between the rivers Trent and Severn*; and the great nodality which contributes so much to its importance is almost wholly modern and artificial. It is, even more completely than most of its fellows, a growth of the Industrial Period.

WEST YORKSHIRE: The West Yorkshire conurbation, which ranks fourth in order of population, is in some respects the most complicated unit among the larger British conurbations. It lies among the Pennine foothills on the West Yorkshire coalfield, the northern section of the largest of our coalfields, and occupies parts of the valleys of the rivers Aire and Calder and of some of their tributaries. Its central portions are on the higher ground between the Aire and Calder valleys and are less completely urbanized than

*At least two other large towns—Johannesburg in South Africa, and Lwów in Poland—are also on water-partings.

the lower slopes. The whole urban area is in the form of a very irregular oval, the longer axis of which stretches from north-east to south-west for about 20 miles through Leeds and Huddersfield, and the transverse axis through Bradford and Dewsbury for nearly 12 miles. It may be compared to Manchester's Ring, without the central city which unifies Greater Manchester. It does possess a direct "brick-and-mortar" unity due to the fact that its area is continuous, though not compact. This conurbation contains five county boroughs and forty-two other urban districts. The factors making for unity among these are mainly the common interests resulting from their direct contiguity and from the fact that the woollen industry, in its various branches, is their principal industry. But in the recent development of joint town-planning "regions" this one conurbation has been divided into a Leeds–Bradford and a Calder Valley "region." This division results from the physical features of the district, which have made its central areas less populous than its margins. The largest city and principal node of routes is Leeds. But Leeds is not centrally placed; it is the north-eastern section of the conurbation and contains only a third of the total population, unlike Birmingham which, though similarly excentric in its conurbation, is populous enough to dominate the whole.

GLASGOW: The fifth of these great conurbations is that in the lower part of the Clyde valley, of which Glasgow is at once the focus and by far the largest part. That city contains just over 1,000,000 inhabitants; and the other six burghs add only a fifth of that number. The small number of the separate burghs offers a striking contrast to the larger English conurbations already referred to; *e.g.* Greater Manchester consists of no less than fifty local government divisions as against Glasgow's seven.

MERSEYSIDE: The sixth conurbation is the urban area inhabited by the workers of the Mersey port and those dependent on them and on the industries of that port. Because of the concentration of its economic activities on the harbour its population is as a whole more densely crowded than that of any other of our great conurbations, while its urbanized area is smaller and much more compact. The City of Liverpool contains two-thirds of its population and occupies its central areas, so that the whole is very definitely focused. It contains only nine separate local government divisions; and its real unity is more obvious and more generally recognized than is that of any other of the English conurbations previously mentioned except London.

TYNESIDE: Along the estuaries of the Tyne and Wear stretch the seaport industrial towns of the Tyneside group. Here the narrow area between the two estuaries, only some 5 miles in width, is so far urbanized that the two may be regarded as forming a single conurbation. In it Tyneside, with four-fifths of the joint population, is clearly the dominant section; and the natural focus is in the City of Newcastle-upon-Tyne, the bridge-head town of the estuary and the largest unit. Although this city contains little more than a fourth of the total population its advantages of position and its traditional importance as the principal city and regional capital of North-East England make it the unquestioned focus of Tyneside.

In a few other cases it is somewhat doubtful whether two neighbouring urban areas have approached so nearly as to justify us in including them in a

single conurbation. Such cases are those of Sheffield and Rotherham, whether Wakefield to the south-east and Bingley to the north-west should be included in the West Yorkshire conurbation, whether the Hartlepools are part of Teesmouth, and whether Eastleigh is part of Greater Southampton.

The seven British conurbations so far discussed may all be ranked among the very large cities of the world in that their populations exceed 1,000,000 inhabitants. They differ among themselves in some important respects. Three of them, London, Glasgow, and Tyneside, have grown round sites of great natural nodality, and therefore round cities each of which has been the principal focus of human activities in its region for a long period. Each of these cities was a bridge-town at the head of an estuary and also on a nodal site at the intersection of important natural routes. Hence in each of these three, the other towns have grown up in direct subordinate relation to the central and more ancient city; that city has been throughout its growth the focus of its communications and so of its commercial, financial, and social life; and thus there is an economic, social, and traditional unity in the conurbation. Merseyside has a similar unity because it is so definitely focused on its harbour, and also because its principal city is so large as to dominate the whole and has been its focus during the whole of the short period during which it has been the home of any considerable population. The Birmingham conurbation is similarly unified by the dominance of its principal town. And though the City of Manchester contains less than a third of the inhabitants of Greater Manchester the geographical features of its area give that conurbation a degree of unity quite comparable with that of Tyneside or Merseyside. The West Yorkshire conurbation alone has neither a central focus of routes determined by geographical conditions nor any one dominant city; hence it has no corresponding tradition of unity, and the realization of its actual unity is not yet widespread, either among its own people or beyond its limits.

A principal fact which emerges from this study is that of the total population of Great Britain two-fifths* are contained in its seven "million-cities"; and these "big seven" contain half of the total urban population.† This concentration is comparable with that of Australia, where a somewhat larger proportion dwells in the two metropolitan areas of Sydney and Melbourne. The second prominent fact is that the thirty-seven large towns, with more than 100,000 inhabitants each, together contain more than half (53·7 per cent.) of the total population; and the third, that 60 per cent. of our population dwell in the seventy-five urban areas of more than 50,000 population. Great Britain is the country in which the Industrial Revolution began and is most fully developed, and hence its people are more fully urbanized than those of almost any other land; but it is not generally realized how many of our people are dwellers in large towns.

During the inter-censal period 1921–31 the total population of Great Britain has increased by 4·7 per cent., while that of the seven "million-cities"

*39·3 per cent. if we reckon only "Census" London, and 41·4 per cent. with the London conurbation, as defined here, credited with 9,150,000 inhabitants.

†The Preliminary Reports of the Censuses state the population recorded in all urban districts at 80 per cent. for England and Wales, and 69·4 per cent. for Scotland.

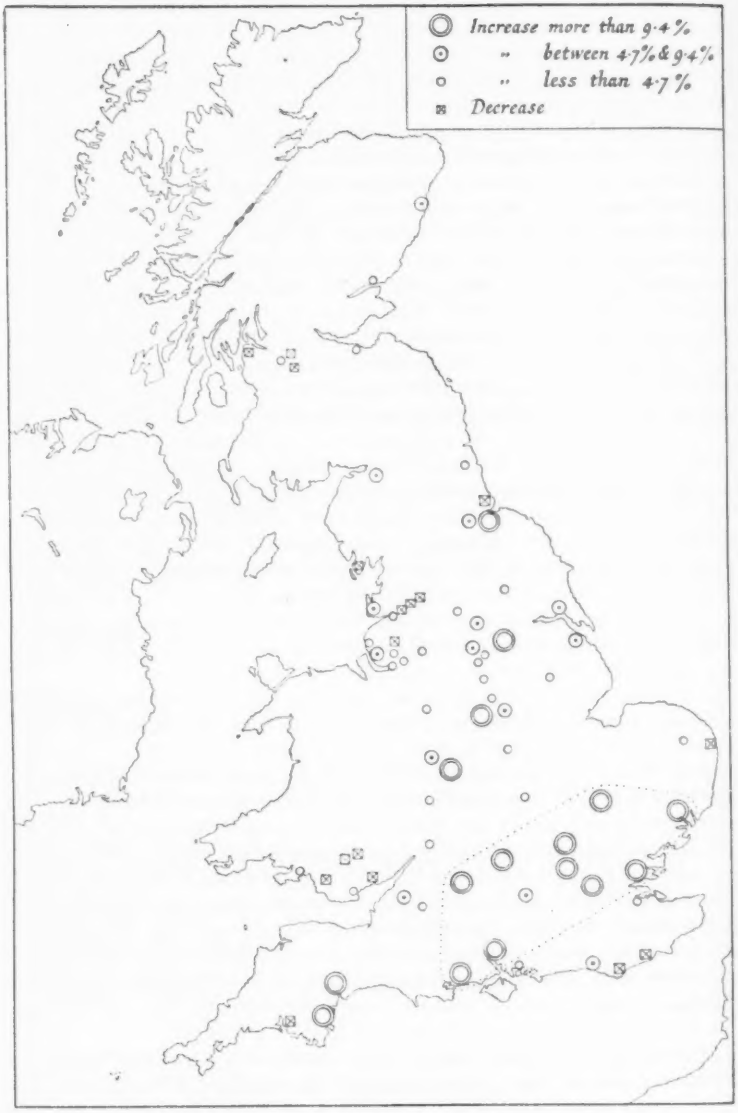


Fig. 2. Changes in Urban Population, 1921–31

combined has increased by 6·5 per cent., so that they contain a larger proportion of the population now than they did ten years ago. On the other hand, the combined population of the thirty other large towns, of more than 100,000 people, has increased by only 4·4 per cent., and that of the thirty-eight towns between 100,000 and 50,000 by only 2·6 per cent., both less than the general rate of 4·7 per cent. In the same period the population in all rural areas has increased by only 1·9 per cent. Hence it is clear that the greater part of the increase is in the big conurbations, which, in fact, have absorbed more than half the total increase in the population of the country. This increase is however very unevenly distributed among them; for of the total net increase in all conurbations of more than 50,000 inhabitants Greater London has absorbed just over a half and Greater Birmingham more than a sixth, leaving less than a third of this urban increase for all the other towns taken together.

In some single conurbations there have been very considerable shifts of population from one part to another, mainly from the central "city" areas to the outer suburbs. One of the most striking instances of this shift is Nottingham, where the city shows an increase of only 2·4 per cent. while its suburban districts have increases ranging from 20·7 per cent. to 33·5 per cent. But such local changes do not affect the magnitude of the conurbation to any great extent; though they are the chief basis for the common, and erroneous, belief that urban growth is more rapid in small or medium-sized towns.

The general distribution of these changes is indicated on the map-diagram (Fig. 2) where the conurbations listed in Appendix I are shown by symbols referring only to the changes in their population since 1921. Some of these changes are influenced a little by the facts that the 1921 census was taken on June 19/20 and that of 1931 on April 26/27; so that the population of many holiday resorts was unduly swollen in 1921, and that of some industrial areas was correspondingly reduced. Thus the figures tend to exaggerate the real increase in such industrial areas and to diminish that in the holiday resorts. Of the seventeen towns showing absolute decreases five are in industrial Lancashire, four are in South Wales, and three in industrial Scotland. At the other extreme sixteen conurbations show increases of more than double the national figure of 4·7 per cent. Of these Teesmouth owes its recent growth to the development of the chemical industry there, and Doncaster to the "new" coalfield. The rest are in the Midlands and south-east, or on the south coast. No one of the older industrial conurbations records so large an increase. In Lancashire only Blackpool and Merseyside have increases greater than 4·7 per cent.; no other has maintained its relative magnitude in the country, and five record absolute decrease. The same is true in varying degree of the other northern industrial regions and of South Wales. The population growth has been mainly concentrated in the south-east and the English Midlands. And the eleven towns within the area of rapid growth in Metropolitan England (shown within a dotted line in Fig. 2) have a combined increase of population which is more than two-fifths of the total for Great Britain.

But the distribution of the increase is better shown in reference to the total population. Fig. 3 indicates the changes of population in every county. This mapping of the census figures brings out several important facts. First the gain in population is confined to the English Lowland. The only counties not

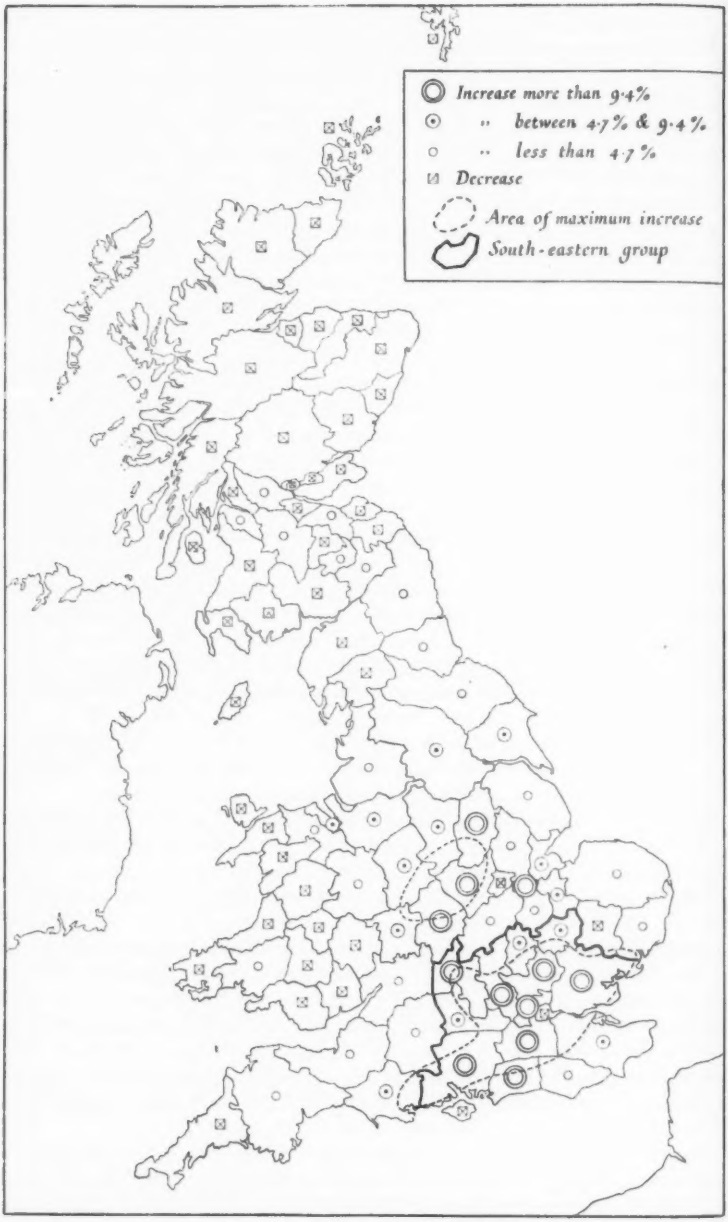


Fig. 3. Changes in County Population, 1921–31

entirely on that Lowland which record increases greater than the average for the whole island are Flintshire and those round the southern Pennines, in all of which the increase is actually on the lowland portions of the counties. The great majority of the highland areas, in all three countries, and the Isles of Man and Wight as well as the Scottish islands, show actual decrease. The only other counties showing decrease are London and the rural counties of West Suffolk and Rutland. On the other hand, the counties which have had a large increase (more than double the national rate) are limited to the Midlands and south-east of England. And the fourteen south-eastern counties marked off on Fig. 3 have together absorbed more than 55 per cent. of the total net increase of population in Great Britain,* and now contain 13,500,000 inhabitants, or about a quarter of the total population on less than an eighth of the total area. By far the greater part of this increase is in the metropolitan area; since within this group of counties East Sussex, the eastern parts of Kent, the west of Berkshire, and most of Bedfordshire and Cambridgeshire, have small rates of increase. More than half the total increase of population in Great Britain during the past decade is concentrated in the metropolitan region, whose total population is now over 12,000,000 in the London conurbation and its satellite areas.

In the second great urban region of Britain, the area within a 50-mile radius from Manchester Town Hall, there is now a population of barely 9,000,000, which has increased very little during the last decade. Thirty years ago this area was somewhat more populous than the metropolitan region within an equal radius from Charing Cross; but the southward migration of the present century has made the metropolitan region decisively the most populous area in the country. Finally we may note that these two densely peopled areas, together with the similar area round Greater Birmingham which lies between them, contain more than half the total population on about a sixth of the total area. And by far the greater part of the increase of the past ten years is concentrated into the two small areas enclosed by broken lines on Fig. 3. Of these the metropolitan region has half the total increase and the much smaller Midland area a little more than a tenth, though the two areas together occupy barely a tenth of the area of Great Britain; thus emphasizing the conclusion that the greater part of the population of Great Britain is clustered into a small number of large conurbations.

APPENDICES

All the figures used in compiling these tables are from the Preliminary Reports of the Censuses of 1931 for England and Wales and for Scotland. For all the local government areas named the reference is to the area as constituted at the date of the Census of 1931.

I. BRITISH CONURBATIONS: Population in 1931 in thousands and Increase or Decrease per cent. since 1921.

Those of four or more Urban Districts are marked with an asterisk, and their constituent parts are given in II. The grouping is not the same as that of the Census, and the figures therefore differ.

*1,122,044 out of a total of 2,021,289.

1. London (Census)	8203	+ 9·7 %
2. Manchester* ..	2427	+ 2·2
3. Birmingham* ..	1861	+ 8·4
4. West Yorkshire*	1433	+ 2·4
5. Glasgow* ..	1312	+ 3·1
6. Merseyside* ..	1287	+ 5·4
7. Tyneside* ..	1083	+ 1·3
8. Sheffield ..	512	+ 0·0
9. Edinburgh ..	439	+ 4·5
10. Bristol, with Kingswood and Mangotsfield ..	421	+ 5·3
11. Stoke-on-Trent*	340	+ 4·1
12. Nottingham* ..	339	+ 6·5
13. Hull, with Cottingham and Hessle	326	+ 8·2
14. Teesmouth* ..	297	+ 9·8
15. Portsmouth* ..	296	+ 1·5
16. Leicester* ..	259	+ 4·0
17. Cardiff, with Penarth	241	+ 2·0
18. Brighton* ..	218	+ 4·9
19. Plymouth ..	208	− 0·9
20. Southampton, with Eastleigh and Bishopstoke	194	+ 10·1
21. Bournemouth, with Poole and Christchurch ..	183	+ 24·9
22. Dundee.. ..	176	+ 4·3
23. Aberdeen ..	167	+ 5·2
24. Coventry ..	167	+ 14·3
25. Swansea ..	165	+ 4·6
26. Blackpool* ..	160	+ 6·1
27. Derby, with Alvaston and Boulton	146	+ 9·6
28. Rhondda ..	141	− 13·1
29. Medway, *i.e.* Chatham, Gillingham and Rochester	135	+ 2·2
30. Southend - on-Sea, with Shoeburyness ..	127	+ 12·8
31. Preston, with Fulwood	126	+ 1·6
32. Norwich ..	126	+ 4·6
33. Blackburn ..	123	− 3·3
34. Grimsby, with Cleethorpes ..	121	+ 6·1
35. Greenock, with Gourock and Port Glasgow ..	107	− 4·4
36. Wigan, with Ince-in-Makerfield	107	− 4·6 %
37. St. Helens ..	107	+ 4·0
38. Burnley.. ..	98	− 4·8
39. Reading ..	97	+ 5·3
40. Northampton ..	92	+ 1·6
41. Rotherham, with Rawmarsh and Greasborough ..	92	+ 3·1
42. Newport (Mon.)	89	− 3·4
43. The Hartlepools	89	− 1·1
44. Ipswich.. ..	88	+ 10·3
45. Aberdare and Mountain Ash..	87	− 11·3
46. York	85	+ 0·9
47. Barnsley, with Worsborough ..	84	+ 5·4
48. Oxford	81	+ 19·7
49. Doncaster, with Bentley with Arksey	80	+ 19·5
50. Warrington ..	79	+ 3·3
51. Southport ..	79	+ 3·0
52. Barrow - in - Furness, with Dalton	77	− 11·4
53. Wakefield, with Stanley ..	74	+ 8·8
54. Darlington ..	72	+ 7·8
55. Merthyr Tydvil	71	− 11·3
56. Airdrie and Coatbridge	69	− 0·5
57. Bath	69	+ 0·2
58. Luton	69	+ 13·7
59. Cambridge ..	67	+ 12·7
60. Chesterfield, with Brampton and Walton.. ..	66	+ 4·6
61. Lincoln.. ..	66	+ 0·3
62. Exeter	66	+ 10·8
63. Hastings ..	65	− 1·9
64. Motherwell and Wishaw ..	65	− 6·0
65. Torquay, with Paignton ..	65	+ 19·2
66. Accrington, with Church and Oswaldtwistle ..	63	− 5·2
67. Swindon ..	62	+ 9·8
68. Mansfield, with Mansfield Woodhouse	60	+ 3·3
69. Widnes and Runcorn	59	+ 2·5

70. Eastbourne ..	57	− 7·4%	75. Worcester ..	50	+ 3·4%
71. Carlisle	57	+ 8·3			
72. Watford ..	57	+ 22·7	Totals	26,837	+ 5·6
73. Great Yarmouth	57	− 6·5			
74. Gloucester ..	53	+ 3·1	All Great Britain	44,790	+ 4·7

II. COMPOSITION OF THE CONURBATIONS

In this list C.B. denotes a " County Borough," M.B. a "Municipal Borough," and R.D. a "Rural District." The rest are "other Urban Districts." The initial figures are those of the list in Appendix I. The figures following each name are the 1931 population in thousands.

2. MANCHESTER

The Inner City (all in Lancashire): City of Manchester, C.B. 766; City of Salford, C.B. 223; Droylsden, 13; Eccles, M.B. 44; Prestwich, 24; Stretford, 57; Swinton and Pendlebury, 33; Worsley, 15.

The Ring: (*a*) in Cheshire: Stockport, C.B. 126; Altrincham, 21; Bowdon, 3; Bredbury and Romiley, 11; Cheadle and Gatley, 18; Dukinfield, M.B. 19; Hale, 11; Hazel Grove and Bramhall, 13; Hyde, M.B. 32; Marple, 7; Sale, 28; Staleybridge, M.B. 25.

(*b*) In Lancashire: Bolton, C.B. 177; Bury, C.B. 56; Oldham, C.B. 140; Rochdale, C.B. 90; Ashton-under-Lyne, M.B. 52; Atherton, 20; Audenshaw, 8; Chadderton, 27; Crompton, 15; Denton, 17; Failsworth, 16; Farnworth, 29; Heywood, M.B. 26; Irlam, 13; Kearsley, 10; Lees, 5; Leigh, M.B. 45; Little Hulton, 8; Little Lever, 5; Middleton, M.B. 29; Milnrow, 9; Mossley, M.B. 12; Radcliffe, 25; Royton, 17; Tottington, 7; Turton, 12; Urmston, 9; Whitefield, 9.

(*c*) In Yorkshire, W.R.: Saddleworth, 13; Springhead, 5.

Total for the Ring: 1252; for the Inner City, 1175.

Of these fifty urban districts only twelve, ten of which are outer suburbs to the south of Manchester, show a large increase of more than 9·4 per cent. on the 1921 population; and twenty-two record a decrease since the last census.

3. BIRMINGHAM

(*a*) In Staffordshire: Smethwick, C.B. 84; Walsall, C.B. 103; West Bromwich, C.B. 81; Wolverhampton, C.B. 133; Bilston, 31; Brierley Hill, 14; Coseley, 25; Darlaston, 20; Quarry Bank, 8; Rowley Regis, 41; Sedgley, 19; Short Heath, 5; Tettenhall, 6; Tipton, 36; Wednesbury, M.B. 32; Wednesfield, 9; Willenhall, 21.

(*b*) In Warwickshire: City of Birmingham, C.B. 1002; Sutton Coldfield, M.B. 30.

(*c*) In Worcestershire: Dudley, C.B. 60; Halesowen, 31; Lye and Wollescote, 12; Oldbury, 36; Stourbridge, M.B. 20.

Twenty-four districts, of which ten, all to the west and south-west, show large increases. No district shows a decrease.

4. WEST YORKSHIRE

All in the West Riding of Yorkshire: City of Bradford, C.B. 298; Dewsbury, C.B. 54; Halifax, C.B. 98; Huddersfield, C.B. 113; City of Leeds, C.B. 483; Ardsley East and West, 9; Baildon, 8; Batley, M.B. 35; Birkenshaw, 3; Birstall, 7; Brighouse, M.B. 20; Calverley, 4; Clayton West, 2; Donholme, 3; Drighlington, 4; Elland, 10; Farsley, 6; Gildersome, 3; Golcar, 10; Greetland, 4; Guiseley, 6; Heckmondwike, 9; Hipperholme, 5; Honley, 5; Horbury, 8; Horsforth, 12; Hunslet, R.D. 4; Hunsworth, 1; Kirkheaton, 3; Linthwaite, 10; Luddenden Foot, 3; Midgley, 2; Mirfield, 12; Morley, M.B. 23; Osset, M.B. 15; Pudsey, M.B. 15; Queensbury, 6; Rawdon, 5; Rothwell, 16; Shelf, 3; Shipley, 30;

Slaithwaite, 5; South Crosland, 3; Southowram, 3; Sowerby, 15; Spenborough, 31; Stainland, 4; Yeadon, 8.

Of these forty-eight districts only five show considerable increases. Four of these are west of Leeds along the north bank of the River Aire. The greatest absolute increase is in Leeds, which has four-sevenths of the net increase of the whole. Twenty-five districts show actual decrease.

5. GLASGOW

Burgh of Glasgow, 1083; Barrhead, 12; Clydebank, 47; Hamilton, 38; Paisley, 86; Renfrew, 15; Rutherglen, 25.

Only Hamilton shows an actual decrease; but there is no considerable increase.

6. MERSEYSIDE

(*a*) In Lancashire: City of Liverpool, C.B. 856; Bootle, C.B. 77; Great Crosby, 18; Litherland, 16; Waterloo with Seaforth, 31.

(*b*) In Cheshire: Birkenhead, C.B. 148; Wallasey, C.B. 97; Bebington and Bromborough, 27; Hoylake and West Kirby, 17.

The considerable changes, two large increases and two decreases, are all in outer suburbs.

7. TYNESIDE

(*a*) In Durham County: Gateshead, C.B. 122; South Shields, C.B. 113; Sunderland, C.B. 186; Blaydon, 32; Felling, 27; Hebburn, 24; Jarrow, M.B. 32; Ryton, 14; Whickham, 21; South Shields, R.D. 21; Sunderland, R.D. 22.

(*b*) In Northumberland: City of Newcastle-upon-Tyne, C.B. 283; Tynemouth, C.B. 65; Gosforth, 18; Longbenton, 14; Newburn, 20; Wallsend, M.B. 45; Whitley and Monkseaton, 24.

There are only two districts with large increases, viz. Gosforth and South Shields R.D. There are seven decreases, all in Durham County.

11. STOKE-ON-TRENT

City of Stoke-on-Trent, C.B. 277; Kidsgrove, 10; Newcastle-under-Lyme, M.B. 23; Wolstanton United, 31.

12. NOTTINGHAM

City of Nottingham, C.B. 269; Arnold, 14; Beeston, 16; Carlton, 22; West Bridgford, 18.

14. TEESMOUTH

(*a*) In Durham County: Billingham, 18; Stockton-on-Tees, M.B. 68.

(*b*) In Yorkshire, N.R.: Middlesbrough, C.B. 138; Eston, 31; Redcar, M.B. 20; Thornaby-on-Tees, M.B. 21.

15. PORTSMOUTH

City of Portsmouth, C.B. 249; Gosport, M.B. 38; Havant, 4; Warblington, 4.

16. LEICESTER

City of Leicester, C.B. 239; Oadby, 5; Thurmaston, 4; Wigston Magna, 11.

18. BRIGHTON

Brighton, C.B. 147; Hove, M.B. 55; Portslade-by-Sea, 10; Southwick, 6.

26. BLACKPOOL

Blackpool, C.B. 102; Fleetwood, 23; Lytham St. Anne's, M.B. 26; Thornton Cleveleys, 10.

III. TOTALS. Populations in 1921 and 1931 and Intercensal Increase or Decrease.

Conurbations	1921	1931		
Seven each with more than a million inhabitants ..	16,532,384	17,605,377	+ 1,072,993	+ 6·5 %
Nine between ¾ million and 1 million	3,089,038	3,229,428	+ 140,390	+ 4·6
Twenty-one between 100,000 and ¾ million	3,113,258	3,246,847	+ 133,589	+ 4·3
All (37) over 100,000 ..	22,717,155	24,064,904	+ 1,347,749	+ 5·9
Thirty-eight between 50,000 and 100,000	2,684,782	2,755,264	+ 70,482	+ 2·6
All (75) over 50,000	25,419,462	26,836,916	+ 1,417,454	+ 5·6
Countries				
England without Monmouthshire	35,230,225	37,354,917	+ 2,124,692	+ 6·0
Wales with Monmouthshire	2,656,474	2,593,014	− 63,460	− 2·4
Scotland	4,882,497	4,842,554	− 39,943	− 0·8
Great Britain	42,769,196	44,790,485	+ 2,021,289	+ 4·7

DISCUSSION

Before the paper the PRESIDENT (Admiral Sir WILLIAM GOODENOUGH) said: Some towns are planned and not built. Some towns certainly are built without having been planned. Sometimes populations arrive and find that there are no houses for them to live in. Sometimes towns are built and there is no one to live in the houses. But whatever happens the distribution of an urban population must always be a matter of the greatest possible interest, and that is what Professor Fawcett is going to tell us about this afternoon. It is a subject that may require some slight introduction. Professor Fawcett requires none.

Professor Fawcett then read the paper printed above, and a discussion followed, Colonel Sir CHARLES CLOSE, Vice-President, *in the Chair.*

Professor J. F. UNSTEAD: I am sure we all feel grateful to Professor Fawcett for his very clear exposition, and the great amount of labour which lies behind that exposition, of the important matter of the distribution of population in these islands, especially the urban population which gives rise to so many problems of both a geographical and a sociological type. In the second part of his paper he dealt with the complicated statistics of relative development in a clear manner, but I think the first part of his paper about conurbations, as he calls them, was the more original and may lead further if that work is continued.

We are apt, I think, to misread the significance of figures of population because of the way in which the administrative divisions cut up populations into various units of arbitrary proportions and record their results under separate headings. We do not easily realize how great expanses of country have been filled up, and are being filled up, by people, except with the aid of some method such as that devised and illustrated by Professor Fawcett. The existence and nature of a great population-group is recognized fairly well where there is some obvious natural cause as, for example, the estuaries of the Thames, Mersey, or Clyde. There we can see the great nodal point, and the consequent central settlement of London, Liverpool, or Glasgow is important enough for the statistics of population to stand out in striking fashion and for the names of the places to get inserted in the maps. But in other cases where the reason for the growth of the population is not so clear the recognition of the size and essential unity of the settlements

may be more difficult, as in cases where the developments are due to the occurrence of coal measures and the possibly sporadic working of the coal. Sometimes the distribution is fairly simple, as in the case of the South Staffordshire coalfield with a well-defined basin structure, and in this case there has resulted a domination of one of the centres, Birmingham, which cannot be overlooked. The matter is less clear where the geological structure is more complicated. In South Lancashire there are two lines of folding: one along the Pennine edge running north and south, and the other extending east and west on the southern margin of the Rossendale Fells; but even here, since these two lines are at right-angles, there is a clearly marked angle between them, and in that area has grown up the group of urban settlements that Professor Fawcett terms the Outer Manchester ring, fencing Manchester itself. In the case of the West Yorkshire conurbation the facts are more likely to be obscured. There the general line of the coalfield runs north and south along the Pennine margin, but the valleys of the Aire and the Calder extend the mining and manufacturing development both upstream into the Pennine Upland and downstream into the Yorkshire Plain, so that Professor Fawcett had difficulty in deciding which of the various settlements in the neighbourhood were to be included in the conurbation. In other areas however the facts are by no means as clear, and to these Professor Fawcett's method might well be applied.

An example may be taken from Belgium. You will remember that in the south-west of that country there is a line of coal development from about Mons in the west to Charleroi in the east. The general line of the coal basins runs east and west, but there is no natural centre of the region, and it is one of those exceptional cases to which Professor Fawcett referred, as it is on a watershed, the portion near Mons draining to the west, and that near Charleroi draining to the east. There is no marked nodality in the area, and consequently there has been no growth of large towns, so the importance of the region tends to escape notice. The largest single settlements, Mons and Charleroi, have rather less than 30,000 people, and these are the only ones that may appear on the small-scale maps commonly used. But in addition there is along the line of coal deposits a series of small towns of more or less the same character with a very considerable total population. Around Mons in the west there are about 150,000 people; in what is called the central region there live another 150,000, although there is no marked town; in the east around Charleroi are 300,000 people. Thus in the whole region there are some 600,000 people, representing one of the great conurbations of the world; and yet neither the ordinary maps nor the statistics bring out this important fact. I do not know whether for this area any maps have been worked out as Professor Fawcett has suggested they should be, but it seems to afford an instance of the necessity of the method, and other cases might be quoted to show that Professor Fawcett's method might be widely applied with great advantage.

I would like to suggest another development and one which might be considered in relation to the region Professor Fawcett has studied. He has dealt with the size of the populations but not with the extent of the areas. I realize the enormous amount of work which would be entailed in working out the amount of country covered by these conurbations, but it would be interesting and useful to know the areas. We now know their relative importance according to population but not in regard to extent. Similarly, we do not know what has happened in the intercensal period in regard to the areas. Have they extended in the same way as the populations? Finally, if figures of areas could be added to the tables of populations which I understand Professor Fawcett is going to publish, it would be a matter of simple arithmetic to put in one more column and indicate the densities of population. How do the conurbations compare in regard to the

concentration of people upon them? That is an important matter in itself, and it would be an advantage if we knew what is happening in regard to this crowding together of humanity. These conurbations are the parts of Britain that are increasing most in regard to numbers, and it is important to ascertain the facts as regards the trend in the changing densities of their populations. Is that problem getting more serious or less serious? If Professor Fawcett could get the figures worked out showing areas and densities of population he would add valuable material to this geographical study, whose social and sociological bearings are so useful. However we have to thank Professor Fawcett both for what he has given us, and for suggesting lines along which further work might be pursued.

Professor FAWCETT: Professor Unstead has said some very kind things about my paper and made some suggestions for further study which are also of great interest. There are two cases in which the Census authorities of a country have made some attempt to indicate the population of an urban area, apart from municipal boundaries. New Zealand records for each of the four large towns the population of what is described as the "urban area" of which the town is the centre. That "urban area" is not further defined. It would seem to be somewhat akin to what I call a conurbation. That is one definite case. In two cases the Census of the United States have made some attempt in the "metropolitan areas" around certain of the big cities. These are defined as "the contiguous urban districts," contiguous, in the language of the Census, meaning simply that the municipal boundaries are contiguous, not that the built-up, or urbanized, areas are continuous. That may be a different thing.

The discovery of such conurbations as that described in Belgium is one that has been made in two other cases by students who have attempted to find out the population of grouped cities or conurbations. The great cluster round Duisburg on the Rhine is one instance, a town which is cited by Visher in his study of the chief urban centres as having a population of 1¼ million. It would however be a somewhat difficult problem to ascertain the precise areas of our conurbations. The only method of doing it would be to plot them out as accurately as possible on large-scale maps—that would mean in this country at least a 6-inch map—and then measure up the areas on the maps. The actual amount of labour involved would be very great. It is extremely difficult, in the first case, to determine the boundaries quite precisely, and after that there would be the labour of measuring them up, and we should be measuring something which is changing rapidly while we are measuring, changing mainly in the direction of the extension of buildings and roads, *i.e.* of the urbanization of areas which were formerly rural, and to an appreciable extent in some conurbations by clearing or loosening out of overcrowded areas. Generally speaking, there has been an increase in the areas during the last ten years in the large conurbations, but I am not able here to state that in precise figures. It is indicated a little by some of the figures which I have given showing that the increase in population is mainly in the outer parts of the conurbation. There has been a shifting from the central areas to the outside.

I think, sir, that is all I can say on these particular points. I thank you very much.

Colonel Sir CHARLES CLOSE: Professor Fawcett has given us a clear view of the distribution of population density in Great Britain, and has shown us how terribly urbanized we have become, and how two-fifths of the total population live in seven monstrous conurbations. He has also emphasized the southerly drift, which has been going on during the last ten years, that is, a drift of population from the North to the Midlands and the south-east of England—generally speaking a relative drift, though in respect of twenty-five towns the Census Report shows actual decreases, mostly in the North.

But there is another and more serious drift. I mean the drift of population from Scotland, Ireland, and Wales into England. It has been pointed out by Mr. Harold Cox that there has been a drop in the population of Wales and of Scotland, and that the population of Ireland has been steadily falling since the Great Famine. The following figures are approximate. The population of Scotland went down by 40,000 during the last ten years' intercensal period, and, making allowance for natural increase, and for emigration abroad, it appears probable that some 60,000 migrated to England. In the case of Wales the actual drop of population was 65,000, but there should have been a gain according to the figures for births and deaths of about 194,000; there was therefore a migration from Wales of 259,000, and most of these must have come to England. As the census dates for Southern Ireland do not coincide with those of this country, the figures for Ireland are not so certain; but it is probable that, especially in view of the recent diminution of emigration to the United States, there must have been an accentuated migration to this country.

The gross over-population of England is rarely properly realized. On 26 April 1931 there were 37·355 millions of people in England, excluding Monmouthshire. The area is 32·209 million acres, so that there are 1·16 persons per acre; that is 742 persons to the square mile, which I believe is the greatest density of human beings in any country in the world; compare that with 42 to the square mile in the U.S.A. That is the disease that we are really suffering from in this country: there are too many of us. The calculations of Sir Daniel Hall show that, to maintain a Western European standard of living, each person requires the produce of 2½ acres of cultivable land—and we have not as much as 1 acre per person. All who wish well to their country must desire to see the speedy arrival of equilibrium between births and deaths, and after that a steady reduction in numbers. You will remember that Abraham Cowley, nearly three hundred years ago, addressed London in these terms:

> "Let the wicked men from out thee go,
> And all the fools that crowd thee so,
> Even thou, who dost thy millions boast,
> A village less than Islington wilt grow,
> A solitude almost."

That is, allowing for poetical exaggeration, the true solution; let us, in reducing our numbers, take care that we get rid of criminal and diseased stocks, our lunatics and our feeble-minded.

I seem to have strayed a little from the narrow geographical path, and I will get back to it by expressing the hope, in which I am sure Professor Fawcett and all other geographers will share, that censuses in this country may always be taken upon the same, or nearly the same, date. As Professor Fawcett points out, it is inconvenient that the census of 1921 should have been taken on June 19, whilst that of 1931 was taken on April 26. All of us who are interested in the subject are grateful to Professor Fawcett for his valuable paper, which puts very forcibly before us the present state and tendencies of the urbanization of this country.

RAILWAY DEVELOPMENT IN TANGANYIKA TERRITORY

BRIGADIER E. M. JACK

THE question of the development of the railway system of Tanganyika Territory has occupied much attention since this country came under British administration; and within the last two years three Reports on the subject have appeared. These are:

Report on the preliminary surveys for a Railway Line to open up the South-West of Tanganyika Territory. By C. Gillman, Chief Engineer, Tanganyika Railways. Dated October 1929.

Report on the Railway System of Tanganyika Territory. By Brig.-General F. D. Hammond, C.B.E., D.S.O. Dated March 1930.

Report of the Tanganyika Railway Commission. Dated September 1930.

These Reports form the subject of the present notice, the object of which is to give the readers of this *Journal* some idea of the problems involved, and of the various solutions that have been proposed. The discussion in the Reports falls under two heads: development north of the Central Railway, and south of it. Space will not permit consideration here of the northern projects, which in any case have involved much less controversy. We will devote our attention therefore solely to the problem of development to the south-west. A brief description of the country is first necessary.

Physical Features.—A large block of high land rising from the plains on either side extends in a south-westerly direction from the Central Railway between Dodoma and Kilosa as far as the northern end of lake Nyasa. The country is very broken and communications are difficult. West of this high land is a large stretch of arid country with a sparse population. East of it lies the valley of the Kilombero and the plain of the Ruaha. South of the Kilombero lie the Mahenge and Songea districts.

Produce.—Tea and coffee are being grown in the highlands, though still to some extent in the experimental stage; and tobacco and cereals, such as maize, wheat, barley, and oats, have been successfully grown. In these areas there are also possibilities for dairy and stock farming. In the Kilombero valley a large amount of rice is grown, and the rivers abound in fish. Parts of the low-lying country are suitable also for cotton, sisal, and maize.

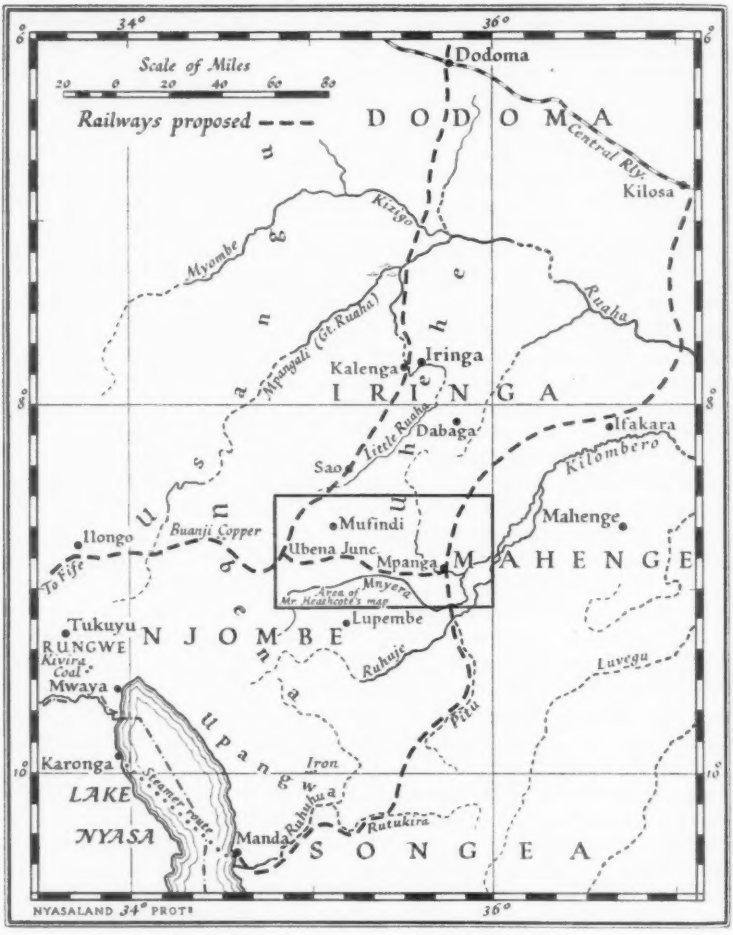
Minerals.—Gold has been found in the Lupa valley, at the south end of lake Rukwa, and copper in the Buanji district (north of Njombe), but in neither case have the deposits yet been proved to be of value. The coalfield at Kivira, at the north end of Nyasa, is said to be plentiful and of good quality. There is stated to be a large outcrop of high-grade magnetite iron ore in Upangwa (north-east of Manda).

European Settlement.—There is European settlement in the districts of Iringa and Dabaga, and southwards, though very scattered, to the Rhodesian border. Country suitable for settlement exists in most of the highlands, but the native population is considerable, so that the area available for alienation is limited.

The various proposals for developing the south-west area, based on former

German and recent British reports and surveys, resolve themselves finally into three routes:

The Kilosa—Ifakara—Mpanga—Manda, or Eastern Line;
The Dodoma—Iringa—Ubena Junction—Fife, or Western Line;
The Kilosa—Mpanga—Ubena Junction—Fife, or Combination Line.



Proposed railways in Tanganyika Territory

Ubena Junction is a convenient name used in the Reports for the point where a branch from Mpanga on the Eastern Line would meet the Western Line. Fife is in Northern Rhodesia, and the idea of connection with Rhodesia is apparent in all three proposals, in the first by steamer across the lake.

Mr. Gillman's Report, which is a summarized form of two much fuller survey reports submitted by the author in 1926 and 1929, gives a detailed technical description of all three routes, with a comprehensive account of the topography of the area, notes on railway policy, estimates, etc. His Report serves to a large extent as the text of the other Reports.

Eastern Line.—This leaves the Central Line at Kilosa, crosses the fertile Ruaha plain, and then follows the foothills of the high country to near Ifakara, the centre of the rice trade of the district. It then continues along the foothills, near the steep and high escarpment of the Iringa highlands, crosses the river Mpanga near the settlement of that name, and makes for the Pitu valley. This is followed to the water-parting, the descent on the other side being made by the valleys of the Ruhuhu and Rutukira to Manda on the lake shore. No special difficulties are met with on this route until the last section over the high country near Nyasa. A note is added on the construction of ports on the lake. The question of feeder roads is discussed. The escarpment on the west, cutting the line off from the Iringa highlands, offers the only serious difficulty in this respect; but Mr. Gillman says that roads would be possible in several places.

The cost of construction only (which is given in all cases without interest on capital during construction) from Kilosa to Manda (470 miles) with 1 in 80 ruling grade throughout, including ports and one boat, is estimated at £4,200,000; from Kilosa to the Mnyera only (250 miles) £2,000,000.

Western Line.—Starting from Dodoma this line crosses a rather barren region and ascends to the Iringa plateau by the valley of the Little Ruaha, where heavy work will be required. From Kalenga, where the first productive area is reached, to Ubena Junction, there are a number of pronounced rises and falls, and other difficulties which will raise the cost of construction. From the junction the line drops, in easier conditions, to the Usangu plain, and reaches Ilongo. From Ilongo onwards is the last and most difficult division of this line. The Fingano escarpment, the Songwe scarp, and other difficult country are described as constituting a "series of stupendous obstacles to railway construction." So unfavourable is the topography in this region that an Assistant Engine Section was studied, and even a Rack Section.

The cost of construction only, to the Rhodesian border (463 miles), is estimated at £5,000,000 with 1 in 50 ruling grade throughout, or £5,350,000 with 1 in 80 against export.

Combination Line.—The possibility of reaching the Ubena plateau from the Eastern Line by a branch going up the Mnyera valley is considered. It would entail some heavy work, but is quite practicable. Cost, from Mpanga to Ubena Junction, for construction to main line standard, is estimated at £1,200,000.

In a final chapter Mr. Gillman sums up the relative advantages and disadvantages of the Eastern and Western Lines from the points of view of cost of construction, of loss of level, ruling grades and consequent cost of operation, of the importance and fertility of the areas served, both those occupied by natives and by Europeans, and of the possible copper traffic from Northern Rhodesia. He considers the Kilosa–Manda route to be geographically, technically, and economically the correct line, and definitely does not recommend the Dodoma–Fife line.

Brigadier-General Hammond was commissioned originally to inspect and report on the Tanganyika Railways, and subsequently, as an addition to his terms of reference, he was asked to express his views on the various routes in a southerly direction discussed in Mr. Gillman's Report. He opens the part of his Report which deals with this subject with a reference to the question of establishing a connection between the railways of Kenya, Tanganyika, and Rhodesia, which he says has been much advocated of recent years. He says that the supporters of this scheme have advanced no reasons economic, administrative, or strategic for it, and in the absence of such reasons have coined a phrase (the meaning of which he is doubtful if they know) and say that the great expense of making a line from Nairobi to Broken Hill is required in order to provide an "Imperial Link." He considers such phrases dangerous, quoting the influence this one has had on the Reports of the local Colonial Development Fund Committee and of the Chief Engineer; and that railway development ought to be based first on the interests of the Territory, leaving connections with neighbouring systems to be made if future circumstances show them to be desirable. He then discusses the three proposed routes.

Eastern Line.—Apart from the Kilombero valley, this line, he says, " is aimed primarily at tapping the area of a neighbouring colony, and in the traffic of that country the Imperial Government is directly interested through the guarantee by the Nyasaland Government of the debentures of the Trans-Zambesia Railway. This interest will become far greater if it finds the money for the construction of the Zambesi Bridge. . . . Any idea of competition for this traffic could not be permitted." He adds that this route leaves untouched the whole of the south-west highlands, except by steamer, and that it would tap none of the country west of Ubena, and little, if any, of Ubena itself. He therefore thinks that this route should be ruled out.

Western Line.—Of this he says only that as far as the Ruaha it runs through barren country, and that little traffic can be expected till Iringa is reached.

Combination Line.—General Hammond says that the first section of this route (Kilosa to Ifakara) is universally acknowledged to be the most promising scheme in the country, with one possible exception. "It opens up the fertile valley of the Kilombero, which is already well known for its rice. There are excellent possibilities of development both in rice and cotton. . . . Sugar production also holds out good hopes. The whole valley can be tapped by means of water transport." He states that, in the Ifakara–Mpanga portion where the line skirts the escarpment, "although the line would run within 20 miles of Dabaga, the escarpment is so steep that no feasible road could be made for motor traffic," and that the railway would in consequence gain no traffic from the western side; but that on the other hand the advance of the railway up the valley would stimulate production. From Mpanga west to the junction this line would serve the European settlement areas of eastern Ubena and also of southern Uhehe.

General Hammond's conclusion is that he strongly advocates the Combination Line as the right solution, even though he recognizes with regret that if no line is built to Iringa it may mean a definite check to the development of that area.

The Tanganyika Railway Commission were appointed "to consider the

question of railway development in Tanganyika Territory, with particular reference to opening up the Rufiji and Kilombero districts and the Mahenge and Iringa Provinces. . . ." After some preliminary remarks the Report discusses the three main proposals.

Eastern Line.—The Commission are satisfied that as far as Ifakara the line advocated by Mr. Gillman would be justifiable. The arguments in favour of this part of the line have been given; they are admitted, and need not be repeated. The Commission consider that the line to Ifakara should be built at once. They are not satisfied that an extension beyond Ifakara to Mpanga would be justified at present, though they admit that some advantages would result from it. In the absence of a railway they recommend development by roads and improved water communications. About the line from Mpanga to Ubena Junction they are somewhat doubtful, owing to its high cost; but suggest that instead of regarding it as a section in the Combination Line it might, if the Eastern Line should eventually be extended south to Manda, be constructed as a branch, to branch line standard, with consequent saving of cost.

Western Line.—The Report quotes evidence which confirms the opinions already expressed that as far as Iringa the country offers little or no prospect of contributing to the revenue of a railway. South of that they think that prospects of European settlement improve as Mufindi is approached. Iringa would, they consider, benefit by the Western Line, but not at all by the Combination; and they add that if the present settlers in Iringa are not assisted by the construction of a railway there will be a setback to European settlement. The southern and more promising districts of Mufindi, Njombe, and Lupembe could be served by either line. The district round Dabaga, on the other hand, they state would be too far away from the Western Line for low-priced crops, while for high-priced they consider that either the Western, by existing roads, or the Eastern, by roads down the escarpment, would serve.

Comparing the two routes to Ubena Junction, the Report states that the western route involves 242 miles of new construction, at a cost of £2,020,000; the eastern, via Ifakara and Mpanga, 354 miles, at a cost of £3,200,000. It would thus be cheaper by £1,180,000 to adopt the western route, while the haul to the coast would be the same by either. But, the Report goes on to say, if the recommendation to build the line to Ifakara is adopted, the comparison as regards new construction should be reckoned from Ifakara instead of from Kilosa. From Ifakara to Ubena Junction the cost would be £2,150,000 as against £2,020,000 from Dodoma.

The Report points out that two branch lines, one to Ifakara costing £1,050,000, and one to Ubena via Iringa costing £2,020,000, could be built for a total cost of £3,070,000, as against £3,200,000 for a single line to Ubena via Ifakara. The Report then considers extension westward from Ubena or southward from Mpanga, with regard to possible traffic from Rhodesia. The Commission form the opinion that agricultural prospects alone would not justify construction beyond Ubena Junction, while on the information at present available they cannot base any recommendations on the mineral prospects.

With regard to the line from Mpanga to Manda, the Commission consider

that it would have some possibilities for native development, and for European settlement in the Upangwa and Songea highlands. For the Tukuyu District (north end of Nyasa) and areas of Tanganyika, Nyasaland, and Northern Rhodesia which have easy access to the lake, this route would be of more advantage than the western route; and it would also have more value for opening up the Kivira coalfield. It is also pointed out that the Manda line would provide a route from Nyasaland to the sea through British-controlled territory.

For these reasons the Commission consider that the project of a line to Manda should not lightly be dismissed; and add that if such a line should eventually be built, the southern highlands could be approached by a branch from Mpanga to Ubena Junction at a much less additional cost than by the construction of a line from Dodoma. The Commission consider therefore that before any final decision can be taken it will be necessary to take into account the interests, mining and general, of the British Territories south of Tanganyika; and to that end they advise that the cooperation of the Governments of those Territories should be sought and their views ascertained.

The final recommendations of the Commission are, as in previous cases, summarized, with the exception of the fourth, the essential parts of which are, in view of its importance, quoted verbatim. They are:

(i) That a railway from Kilosa to Ifakara should be constructed at once.

(ii) That British Territories south of Tanganyika should be consulted with a view to cooperation; and if negotiations do not lead to the early adoption of a constructive policy, measures for the development of Tanganyika should be taken independently.

(iii) That the continuation of the railway from Ifakara to Manda or even to Mpanga would not be justified at present.

(iv) That the Commission "are all in agreement that without . . . a railway to the neighbourhood of Ubena Junction by one of the alternative routes discussed, the Iringa Province cannot be effectively developed.

"As a means of opening up this Province, if negotiations do not lead to a decision to extend the railway . . . to Manda, and . . . the construction of a branch from Mpanga towards Ubena Junction accordingly falls through, we recommend, the Chairman and Mr. Chitale dissenting, the construction of the Dodoma–Iringa–Ubena Junction line. . . .

"We would however desire to emphasize that this recommendation is based on the assumption that H.M. Government will provide the capital free of interest for a period of at least twenty years, as it is not anticipated that the railway will meet its expenses within that period. . . .

"Having regard to the infertility of the country lying between Dodoma and Iringa, and the unpromising character of the area through which the continuation . . . would pass, the Chairman and Mr. Chitale consider that . . . no justification can be found for the construction of these 250 miles, more especially as they consider that . . . the more fertile areas . . . lying to the south and north-east of Ubena Junction could be eventually served by the alternative eastern alignment."

(v) That the construction of a line westwards from Ubena Junction should not be undertaken at present.

It will be seen that the problem is complex. There is a conflict of interests, and considerable diversity of opinion. It would be presumptuous of the layman to attempt any final judgment when experts disagree so much; but one may be permitted a few comments.

The point that strikes one most forcibly is that no one seems whole-heartedly in favour of the Western Line, save doubtless the Iringa settlers themselves. Mr. Gillman, being the proposer of the Eastern route, is naturally wholly for it; but one may say in passing that his admirable and closely reasoned Report shows an evident desire to be fair to the other side. General Hammond is quite decided that, in the interests of the country as a whole, the Combination Line is the best. The Railway Commission, it is true, recommend by a majority the Western Line as far as Ubena Junction, but rather as a second choice, and subject to certain conditions.

The Commission as a whole think that if the Territory should eventually be committed to the line to Manda, a branch to Ubena would be justifiable; and granted such a branch, they would apparently be ready to leave the Iringa settlement to its fate; or perhaps it would be fairer to say that they would be satisfied that this would sufficiently meet the needs of the Iringa Province. One might ask why the same railway to Ubena, without the extension to Manda, would not fulfil the same purpose; but it must be remembered that the Commission do not think the Ifakara–Mpanga section necessary on its own merits, and that they note the fact that the two branches Dodoma–Ubena and Kilosa–Ifakara could be built for less cost than the one branch Kilosa–Mpanga–Ubena. Failing access to Ubena by a branch from the Manda line, the majority fall back on the Dodoma–Ubena solution, but guard it with a most important condition as to interest on the capital. The two dissentients feel so strongly on the subject that they record their opinion that "in the present circumstances no justification can be found" for the construction of this line.

While there are obviously other considerations to be taken into account, one is left with the impression that the case for the Western Line is, on economic grounds, not a strong one.

A point that is made against the Eastern Line, south of Ifakara, is the difficulty or impossibility of access to the Iringa highlands. General Hammond says that "the escarpment is so steep that no feasible road could be made for motor traffic." Mr. Gillman, on the other hand, says that "graded roads suitable for motor traffic are possible at several places, though they will of course be costly." The Railway Commission, with ample information at their disposal, refer in para. 33 of their Report to the possibility of connecting Dabaga with this line by a road down the escarpment. It would seem that the last word has not been said on this subject.

Finally, a word on the question of the connection with Rhodesia, or "Imperial Link." In spite of General Hammond's strongly expressed views on this subject, the Railway Commission seem to have observed his principles more thoroughly than he has. General Hammond recommends "the Kilosa–Ifakara–Fife route as that which should be adopted for a southern railway" without any consideration in his Report whether this route would, beyond Ubena Junction, be economically profitable to the Territory, nor whether a connection with Fife (in Northern Rhodesia) is required; nor does he make any

reference to the very serious difficulties of the final portion of this route. The Railway Commission, on the other hand, in considering the Mpanga–Manda portion of the Eastern Line, do so largely from the point of view of its benefit to the districts of Upangwa, Songea, Tukuyu, and the Kivira coalfield, all within the Territory; though it is true that they include also its advantages to areas of the southern Territories. On the whole it would seem from the evidence in the Reports that if a through route to Rhodesia were ever contemplated, the Manda route would have some distinct advantages. The question whether it is preferable for the people of Nyasaland to have access to the sea through Tanganyika Territory or through Portuguese East Africa is clearly beyond the province of this article.

THE HEAD WATERS OF THE MNYERA RUAHA

MICHAEL A. UNWIN HEATHCOTE

IN the autumn of 1929 it was suggested to me that if I wanted to do some useful survey work in Africa I might perhaps be able to choose my field of work so as to be of some assistance also to railway development in Tanganyika. On arrival in Dar-es-Salaam I found that ideas and circumstances had somewhat altered from those prevailing before the Hammond report was issued. This report recommended that the line, instead of following the projected route to Songea and Lake Nyasa, should turn right at Mpanga, climb the Ubena escarpment, and then continue on its way to the boundary of Northern Rhodesia. This line would link up with the old Dodoma to Fife Survey in the neighbourhood of Emmaberg Mission. The distance from Mpanga to Emmaberg is roughly 65 miles. One route had been explored by a German Survey party, but otherwise the map was a blank, and most of the country unknown.

When therefore Mr. Gillman, the chief Engineer, suggested that it would be helpful to the Railways if I would explore this region, I readily agreed to go. Before I left England the Society lent me a plane-table and other instruments; and a little later the Council granted me £100 from the Expedition Fund to help me remain in the field long enough to complete some really useful work, as I found that my own resources would be insufficient to stand the whole cost. I would like to express my grateful thanks for the Society's generous help.

The idea, then, was to carry out a reconnaissance survey in the country lying between Mpanga and Emmaberg. It is a region of hills, scored by deep valleys which run in every direction, and it varies in width, *i.e.* north to south, from 25 miles to about 8 miles. It lies immediately to the south of the great escarpment which at Mufindi runs east and west, then towers above the Kilombero Plain for more than 100 miles, and later becomes broken up and less distinct. There is high grass upon the hills and swamp in the bottoms: elephants and a handful of natives are the only inhabitants.

To reach Mufindi, where I expected to be able to begin the work, entailed a march of three weeks from the Central Railway; and owing to the exceptionally heavy rains it was late in May before I was able to make a start. Mr. Gillman gave me every help in equipping the "safari," lent me a spacious tent, and

collected for me a gang of porters. Without his assistance and advice I felt I should never have started at all, and I am very grateful indeed for all that he did. So on 23 May 1930, after one of the most frantic weeks of my life, I departed with my little band of Wanyamwezi from Kidete, and taking the path leading south we went into the bush. There were thirty-nine porters besides a cook, my bearer, and a guide.

The path wound its way up the valley of the Romuma, amid flowering shrubs and forest, then over a pass in the hills, and sharply down again into a more arid country which drains into the Great Ruaha. I very soon found that my daily progress was being regulated to a large extent by my porters' passion for their food. *Chacoula* (food) seems to be their tribal motto, their one ever-present thought. During the approach march we would time our start for four or five in the morning, so as to reach our intended camping-place by ten.

In the early days striking camp in the dark was rather slow, and we were often late in getting off. I have suspicions that there was method in this, for they hoped we might still camp at ten o'clock, and thus they would have an easy day. And so they did—at first. If we happened on a village with plenty of food at about the hour of ten, there was little chance of getting any farther that day. For the headman always swore that there would be no more food or water unless we walked on for three hours, and the map was so vague and inaccurate that it was hard to contradict him; so there was generally nothing for it but to camp where we were.

Thus it was seven days' march to the Great Ruaha, whereas I had reckoned on only four. The river was high, and the current strong, so that with only one canoe it took three hours to get ourselves and all the loads to the other bank. But once across we followed the main "road" through several villages till on June 5—the fourteenth day on safari—we reached Iringa.

During the whole safari I found that I had a far better idea of my whereabouts when making my own map than when I had to rely on the old German 1/300,000. But I must in fairness add that confusion is most often due to the fact that places and districts are nearly always called after the local chief or headman, and when he dies or moves elsewhere the name of the place of necessity changes—Msangule's becomes, say, Forembega's.

After leaving Iringa I followed up the right bank of the Little Ruaha, over broad-backed grassy hills, till at Klussiro the path struck patches of forest, and a day later we came to the edge of the escarpment at Mufindi. We camped on the very brink, not far from the Old Schneider farm, and the view was indeed immense. To the south, some 10 miles away and dominating the whole landscape, rose the Kisitu ridge, standing up 1000 feet above the general level of the country, sending out long spurs in every direction. Behind it could be discerned the tops of the hills that flank the river Mnyera, whose course I was to endeavour to trace, and behind again rose the heights of Lupembe. To the left, at the foot of the scarp, was a large area of swamp, and behind that, over some low hills, there appeared to be a sudden drop. To the right, the hills—mostly bush covered—seemed to rise in steps towards the Ubena plateau, while the escarpment stood up like a gigantic wall, seeming to become merged in the highlands on the western horizon.

On arrival at Mufindi I began immediately to think out how best to tackle

the problem. I was fortunate in having three survey beacons in the area. On these I could hang my traverses, and from them I might hope to resect my position at other stations. But here I was disappointed, for distances were great, and one or other of the beacons was almost always hidden behind a hill. Much to my surprise and joy however there was a fourth beacon, named Ngololo, placed on the very edge of the escarpment at Mufindi; and this point I elected to take for my starting-point, for I felt sure that such a prominent beacon would be known to the Survey Department and that I should be able later to find out its coordinates. This information was unhappily not available while I was in the field, but before I began to plot the traverse it was forthcoming, and thus I was able to use the point.

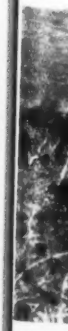
The other three beacons were named Kisitu, Kinega (or Kitalumwa), and Nyakipambo, and their relative coordinates were given to me by the Survey Department before I left Dar-es-Salaam.

A German planter, Mr. H. Aumann, lived at the bottom of the escarpment, just below the spot where I was camped, so I decided to go down and see him. He was kindness itself; he gave me much information about the country, and advised me to send word to the chief at Massagati to bring rice for my porters, as I had been having a hard time to get food for them. However, few though the natives were in this region, I found it much less difficult to get food for them down below than it had been on the approach march.

From Aumann's farm I went straight to Kisitu in order to have a look over the ridge, and to find a way down south to the river Mnyera. I can remember standing on the top, fascinated by the scene, looking down into the unknown and feeling very much the thrill of being about to do a real bit of exploring; and how the local tribes, a lazy and most unenterprising people, insisted that there was no path, no men, and no food in the country below us: moreover "Mjani Mingi, Bwana Mkubwa"—"tremendous grass"—and a hundred other excuses and reasons for not venturing down there.

On the next day, whilst descending a steep path through grass that was well over our heads, the wheel refused to register, and I was suddenly without any means of measuring distance. Very fortunately I had set up at the beacon a sub-base of 50 metres. As both ends of it were visible from the camp down below, the situation was saved, and I was able to compute my position along a bearing from Kisitu. On the next day's march, and in fact for six weeks afterwards, I had to rely on the "time" method to give me my distance, for I felt that there were too many things to be noted to permit of counting my paces. We came that day to the Mnyera, and camped beside it at a height of 1155 metres, a drop of 414 metres since leaving Kisitu. As there was no path by which I could follow the river either upstream or down, I went next day to Huwuki, only a mile or two away, and camped on a hill. From here there was a good view to the north and west, and by making several excursions to different points of the compass I was able to map quite a big stretch of the Mnyera. A day's march from Huwuki brought me to Pangani, a fairly populous district. Here there was a big swamp, some 500 metres across, through which flows the river Itete. From Pangani, 1225 metres, we climbed in a day to Kinega, 1537 metres, where I closed my first traverse on the beacon.

The daily work consisted in making a compass traverse from camp to camp,



The Great Ruaha

Crossing the old Ruhuje, now only knee-deep

Mnyera Valley near Lihere

Near Galongole in the Romuma valley, ***Kilosa Province***

Ifofumo Falls

Gorge below Ifofumo Falls

Kilosa Province

Ifojamo Falls

Gorge below Ifojamo Falls

reading the aneroid at stations, river crossings, and hilltops, and all the while making a sketch of the country in the field book. Every evening at 17.00 hours (sun time) I boiled the thermometer and computed the difference of height from the previous camp. In this way a chain of "bench marks" is arrived at, on to which are hung the aneroid heights, corrected of course for the daily variation of pressure. It is considered necessary, when on the march, to halt every fourth day in order to plot a fresh curve of hourly variation.

While in camp at Kinega I contracted veldt sores, and found myself suddenly unable to walk, so the boys cut bamboo poles, and with these and my Roorkee chair we constructed a machila in which I was carried to Njombe, where I hoped to find a doctor. To pass the time, and to try to forget the pain, I continued to take bearings and sketch the country; but our rate varied so much with different carriers and changing conditions of country that I fear I went somewhat astray over this section of the traverse.

Njombe is nothing more than an administrative post in a setting of barren-looking hills. It is however built beside some rather beautiful falls, just where the Ruhuje takes its first plunge off the highlands and begins a headlong rush to the Kilombero plains. I was unfortunately laid up here for twelve days. It was bitterly cold, even in the daytime: there were practically no natives, no bazaar, and no food, so my porters hated it. When at last I was able to go, I decided to follow down the right bank of the Mnyera, which rises only a mile to the north of Njombe. For I was bent on finding a big waterfall, the existence of which I knew from native information and the sound of which I think I used to hear at night from Huwuki Camp.

I was at first put off with several little cascades; but I knew from the nature of the country that there must be a big drop farther downstream, and so there was—a magnificent fall some 70 metres in height, called by the natives Ifofumo. It was rather a steep climb down to the bottom of the gorge—the only place from which there was a view of the falls complete—and I noticed that none of the boys went anywhere near. They seem to shun waterfalls and gorges, as though they were the evil eye; and they take no interest whatever in scenery, unless indeed there be *nyama* (meat) in the picture.

Having now discovered my waterfall, I had to fix its position as soon as possible. A short traverse northwards of about a mile took me to a certain tree, which had been pointed out to me when at Kinega as being in the vicinity of the waterfall I was seeking, and accordingly I had measured out a sub-base at the beacon. This was nearly three weeks before, but fortunately the pole was still standing, so that I was again in a position to measure the angle subtended by the 50-metre base and to compute my distance from that beacon. For direction I had a ray drawn on my plane-table. I was thus able to start a fresh traverse, free from the constant feeling that past errors were accumulating and that the traverse was rather "at sea."

I now made for Emmaberg Mission in order to join up with Mr. Gillman's Dodoma to Fife Survey. The return to higher regions brought on a touch of fever, which made it a considerable struggle even to boil the thermometer; but this had to be done every day, well or ill, or the whole hypsometric traverse would fail. In this case the only reason for my going to Emmaberg was to find its height relative to other points on my map. This done, I marched eastwards

over rather heavy bush country for two days, passing near Kinega and joining up with my previous traverse. I was also able to resect my position at Camp 41, on the second day. A third day's march took me back to Aumann's farm, where I found a great welcome, a mail, and rice for the porters.

Having explored the western half of my area, I now began to look for a possible route for a railway to get down to Mpanga. Just below Aumann's farm, at a height of 1200 metres, the Ruaha goes into a big swamp, where it is joined also by the Fuagi, Nyalawe, and Kigogo rivers. Skirting this swamp along a very zigzag path one comes in about four hours to Makungu, where there were quite a number of native houses. From here there appeared to be two alternative routes: either to follow down the valley of the Ruaha, or to continue eastwards keeping close under the escarpment. I chose the latter, as, according to native information, it seemed a more likely route. I walked along the base of the scarp for nearly two days, and then came to the river Ruiga, which, after falling off the scarp, flows eastwards for a mile or two, and then turns to the south. I thought that its valley might offer a way down, and I therefore endeavoured to follow its course along the hilltops; but alas, the Ruiga turned suddenly east, and took a plunge, while the path kept straight on over a series of precipitous hills, with deep valleys on both sides, and grass well over my head. There was no way out but to go on, wherever the path led. After three days we came to a point where the ground suddenly dropped. Here was a view to the south and east—densely forested hills, and countless valleys leading to the Kilombero Plains; and beyond the plains, resplendent in the sunlight, could be seen the slopes of the Mahenge plateau far away to the east. We dropped then rapidly to about 520 metres and camped at Dodoma. Here we were in quite a new land. Instead of being on grassy hilltops, we were in dense forest country, and encamped in a valley among bananas and paw-paw trees. At Uhadi's next day we found any number of natives, and from our camp we overlooked little *shambas* of rice.

From Uhadi's onwards we encountered many natives, and every little corner seemed to be given over to growing rice. There were also paw-paw and banana trees in great profusion. Walking eastwards, and again climbing up over several ranges of hills, mostly through dense forest, we dropped down at last into the valley of the Mpanga; and after following down its right bank for some two hours, the hills suddenly receded as we came out on to the plain, and I saw on the other bank a red-brick building which I guessed to be Mpanga Mission. Crossing the river by canoe, we camped on the north bank, and enjoyed a rest on the following day. The height of the river bank I computed to be 271 metres, that is to say, we had descended 1400 metres since leaving Emmaberg. It was when entering the canoe to cross the river that my bearer dropped the compass overboard. He was very upset and thought I was going to throw him in also. It was retrieved, and used to the end of the safari.

At Mpanga I had come to the limit of my area, and had linked up with the projected railway route from Kilosa, *via* Ifakara and Mpanga, to lake Nyasa. Mpanga, it will be remembered, was to be the junction for the "combination line" to Ubena and Fife, but my observations on the march from Makungu had failed to disclose a way for any such line to negotiate the first part of the escarpment, and I felt my next step must be to go back and try to follow the course of the Ruaha.

I made for Taveta, where I was told I should strike the Mnyera again, and I hoped to be able to follow up the valley, and to turn northwards up the Ruaha from their confluence. But one can never follow an African river, and now every conceivable obstacle seemed to be put in my way. We had progressed only a little way beyond Taveta, on the south side, when the banks became so steep that the path was nearly impossible for the porters to follow. The guide then declared that there was no path any farther, and that the only way to go was by a circuitous route which would take me first away from the Mnyera and then follow it on a parallel course some way to the south. So this path I had to follow, and for four days we fought our way uphill and down through the grass. In one of these deep valleys we met with elephants, but there was no habitation at all until we reached the village of Lihere on the fourth day. We then came to a region of long rolling hills, like great caterpillars, between which flowed the Mnyera. We dropped down sharply to 1045 metres, and crossed it by a bridge of bamboo poles. The valley here (at Camp 58) was rather attractive, and I stayed for four days, during which time I climbed various hills in the neighbourhood, and mapped a fair stretch of the river.

All efforts to penetrate downstream failed; the country seemed to consist of range after range of hills, and it was useless to think of trying to force a way without a path, as I did not know at all how far it would be to reach my objective. The natives appeared to be terrified of the very mention of the Ruaha, and were determined not to go near the river in this region. They told my porters that there was a lake full of huge serpents just near the confluence of the two rivers, which was my immediate goal. It was not till I reached Kiwigiri that I actually discovered the plot which was to keep me from visiting this area; and I could get no one to go. It seemed to be more than just laziness, for they were petrified at the very idea. Perhaps there lay in that direction a flourishing village, and they were afraid that I had come to collect taxes; or, more likely perhaps, they wished to prevent me from blundering into some sacred burial ground, or some school of witchcraft.

From Kiwigiri I went to Masasi's (Camp 63), where there was, I was told, a bridge across the Ruaha. During this day's march I had on my left a fine panorama of rugged peaks and spurs forming the eastern end of the Kisitu ridge. By sketching this panorama and taking careful bearings from Station 4 of that traverse, from Camp 63, and again from a hilltop overlooking the river Ndulu, I found I was able so to appreciate the lie of the country as to be able to draw in approximate contours without difficulty. I continued northward through bush country and over less precipitous hills, till I reached Makungu again, thus making a complete circle and closing the traverse. Returning to Masasi's I crossed the Ruaha, and made for the house of a *jumbe* (headman) called Sambili Kunongo, *en route* for Mpanga again.

At one camp I had a distant view directly towards my goal (the junction of the two big rivers), but both were evidently flowing in deep gorges, as I could see only the tops of the hills. Every endeavour to discover a path met with a negative answer from the local natives. On the march next day I found a path leading straight in that direction. But the trail was barred with a little curtain of grass, and it was evidently not intended that I should pass. I was however determined to go, and I stepped over the barrier. The guide became instantly

furious, and sent a man back to warn the *jumbe* that I had dared to enter the forbidden trail. A little later two men with spears arrived at the double, and went on ahead to organize a welcome for me. I explained however that I should only go to the top of the hill, and thither I went. Unhappily my tent and baggage had gone on ahead, and it was already afternoon, so that I had no course but to follow on as soon as I had had a look. What I saw from that hill is not very clear, for what I took to be the confluence of the Mnyera and the Ruaha was, I think, not so, but was actually the point of one of the big S bends which appear on the German survey of 1910. Owing to the distance and to the depth of the gorges, I could not see which way the waters flowed, for I could see no water at all. So what exactly happens to the Mnyera at this spot, where there is undoubtedly a very big drop, is still wrapt in uncertainty.

This march from Masasi's to Sambili Kunongo occupied four strenuous days, and I arrived on the morning of the fifth. I remember it as the most exhausting stretch of country on the whole safari, the hills being extremely steep, the path rough, and the grass really terrible. Also, it was by then late in September, and the sun was gathering power. There was so much to map that I often walked all day. Just before Uhadi's we joined the former traverse, and the following day once more walked along beside the Mpanga river to the ferry opposite Mpanga. Here I recorded the barometer, thermometer, and wheel for the last time, rather sorry that it was all over.

The way home now lay through Ifakara and Kiberege to Kilosa, and I decided to make Ifakara by canoe. We had to walk first to Mkasu, which is on a rise in the middle of the Kilombero, the Ruhuje on the east side, and the Mnyera on the west. Here I learnt that owing to the Ruhuje having burst its banks, and joined the Mnyera much earlier in its career, a long stretch of the Ruhuje was now too shallow to be navigable, so that we had to walk on to Ngombo, two days farther to the north, where we all embarked in six canoes. During this march the country was open and flat, and reminded me very much of the delta in Egypt. I was much amused at the terror inspired among the boys by the hippos. Although it is true that he has a nasty habit of rising under a boat, the hippo is generally a most amiable beast. We reached Ifakara in six days, and I decided to continue the march to Kilosa; for I felt no wish to come suddenly back to the stern realities of civilization, and I hated the very thought of a motor car.

I ought, in conclusion, to express my thanks to Mr. R. W. Norton, of the Tanganyika Railways, for helping me to ink in the contours on the map, and also for many hours' work in helping me to compute barometer heights. I would also like to thank Mr. R. L. Hine, F.S.A., for reading this paper in MS. It is my hope that the map, compiled with difficulty and at considerable expense, may be of more than mere academic value—that it may, in fact, materially help towards the construction of the railway that is proposed.

Survey

The western half of the map hangs on the four beacons previously mentioned; while the eastern half is a closed traverse. It is very probable that the distance from Kisitu to Mpanga is more than it should be, that the traverse needs to be compressed to allow for the winding of the path. But until the position of Mpanga in relation to Kisitu is accurately known there seems nothing to be gained

by guessing at a correction, which will almost certainly be wrong. The value of the map lies not in great accuracy as regards the distance traversed but in giving a picture of a hitherto unknown area.

Although I took with me a theodolite, lent by Mr. Gillman, and a short-wave wireless receiver, with a view to fixing some points geographically, I was in this completely unsuccessful. The theodolite, the only one I could obtain, read only to 30″ on a vernier, and such results as I obtained were not nearly accurate enough. Not once was I able to pick up the time-signal from Issy-les-Moulineaux. Various German stations were heard, and once I listened in to a conversation in progress over the Atlantic telephone; but the time signal I failed to find. Later on the set became uncontrollable owing to the failure of the grid bias battery, and I gave up trying.

Heights

Assuming 1673 metres to be the height of Emmaberg Mission, the river bank at Mpanga I computed to be 271 metres—a fall of 1402 metres. Whilst on two different safaris Mr. Gillman obtained 1673 metres for Emmaberg Mission and 287 metres for Mpanga, or a fall of 1386 metres. We differ therefore only by 16 metres. But in order to agree with the railway maps, and because my own figure would mean a difference of 220 metres between Mpanga and Kilosa against an actual difference of only 204 metres obtained by Mr. Gillman, I have adopted his figure of 287 for Mpanga, and adjusted the intermediate heights accordingly.

Climate

During the whole time I was surveying the sun was north of the equator, and it was the season of dry weather. The noon temperatures varied from about 19° C. at hill stations to 28° C. in the plains. One interesting phenomenon was noticed by me. Every morning the mist rose over the Kilombero Valley and hung there like a blanket, till the wind began to blow from the south-east and drove the mist before it up the valley of the Mnyera, with the result that in this region it rained almost every morning from seven to eight, and sometimes up till eleven. I remember this because every time I decided I would have breakfast on the march, down came the deluge, drenching me and reducing my field book to pulp.

TWO EXPEDITIONS TO SPITSBERGEN, NORTHEAST LAND, AND THE NEIGHBOURING ISLANDS

CHRISTOPHER T. DALGETY

IN June and July 1930, with Captain J. H. McNeile, M. J. Ingram, and S. Hederström, I made an expedition to Svalbard in order to study bird life. The ice conditions were unusually favourable, and localities very seldom visited were approached that year without difficulty.

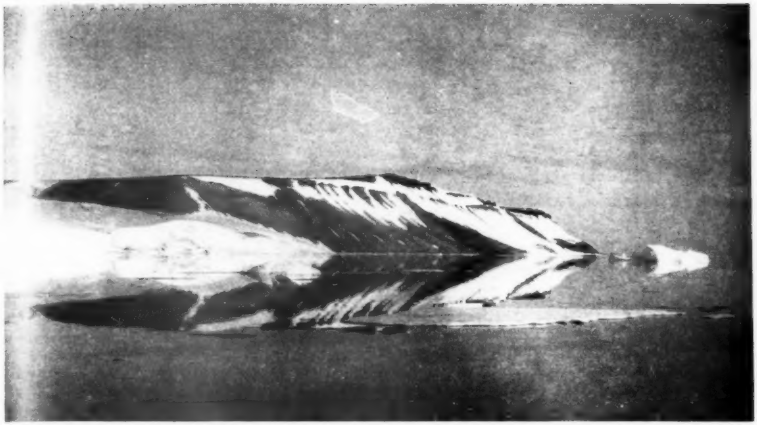
The party left Tromsö on June 14 in the *Ringsael*, 66 tons gross, captained by Victor Corneliussen. A landing was made at Horn Sound four days later, and on the 19th they entered Ice Fjord, remaining there till the end of the month. On July 1 they passed through Foreland Sound to Kings Bay, and learned that there had been open water there throughout the winter. After a couple of days at Liefde Bay a course was set for Northeast Land and Hinlopen Strait, and on July 5, after a brief visit to the islands off Murchison Bay, the

Ringsael reached Palander Bay. On the 1913 edition of the Admiralty Chart Palander Bay is shown as a small inlet on the south side of Wahlenberg Bay; in reality it is much larger and constitutes a southern branch almost half the size of the northern (Wahlenberg) portion. This is shown more correctly in the 1931 edition. Here some pack-ice was seen for the first time in the form of large floes and fields only recently broken off the land-fast ice at the head of the bay. Up till then the only ice seen had been small bergs, as, for instance, at Kings Bay. The inner portion of Palander Bay was completely filled with land-fast ice, but it was breaking up, and on the 6th a field which covered the whole width of the bay and about 2½ miles across broke off and drifted to the west. The plant life on the cliff-faced hills south of Palander Bay seemed more luxuriant and the flowers larger than elsewhere in Spitsbergen.

On July 8 a temporary return was made to Liefde Bay, and two of the party went into camp on Reindeer Peninsula. The ship returned on the 16th, after landing Hederström at Ice Fjord. On Reindeer Peninsula sanderlings were noted as fairly plentiful; a nest of Ringed Plover was found; but of most interest was the discovery of newly hatched knots—this is the second time the knot has been recorded in Spitsbergen, and the first time that it has been found breeding there.

On July 18 and 19 the *Ringsael* moved south through Hinlopen Straits, eastwards along the south coast of Northeast Land, and north round Cape Mohn to Great Island. Pack-ice was completely absent, but there was ice blink over Wyches Islands to the south-east. There was fog during the passage up the east coast of Northeast Land, preventing observation. Great Island in relation to Cape Leigh Smith was considered to be about 12 miles north of its position on the Admiralty Chart. There was a 4-knot tide in the channel between the island and Cape Leigh Smith. The ship went up the west side of the island; except in the north the coast is an ice cliff, lowest towards the south. Landings were made on the north on the bare ground which here fringes the island ice-dome. The bare ground is mostly shingle, but there are outcrops stated to be dolerite sills, mostly to be found at all promontories. There is soft mud at the immediate edge of the ice-cap. Vegetation was very scanty, consisting of mosses and lichens, and only one flowering plant. Cape Leigh Smith was clearly visible across the strait, and is described as closely resembling the cliffs at Vega Bay and as in all probability dolerite. A few nesting pairs of Ivory Gulls were found on the island; the common reports of a great colony here seem erroneous and due to the frequent confusion between Great Island and White Island, due partly to the continued use of the name Gilles Land.

On July 21 an attempt was made to reach White Island, but the ship was stopped by ice about 15 miles to the west. No lanes could be found in the ice, and lack of time prevented further effort. (Andrée's remains were found on White Island on August 6.) A course was then set to Wyches Islands. Ice surrounded the group except the west side of Swedish Foreland, the edge of the pack stretching south-west to Cape Arnesen on Swedish Foreland; there was also a small amount of land-fast ice along the west side of the Foreland; and from Cape Hammerfest at the south end of Swedish Foreland the edge of the pack ran south-eastwards. The return journey was begun on July 22, the route lying east of Edge Island. A tongue of pack-ice jutted to the west



Cape Selander, Wahlenberg Bay

Entrance to Palander Bay

1100-foot mountain, south side of Palander Bay

Looking across Liefde Bay from Reindeer Peninsula to Monaco Glacier and Emperor William Mountains

against Stone Foreland, the east point of Edge Island, but was passed without difficulty. This was the last ice seen, and Tromsö was reached four days later, on July 26.

There was little rain, but the sky was usually clouded over. Snow fell on one day only, but soon turned to rain, on July 14. At Reindeer Peninsula it was very noticeable that the rain always came from the north.

On 10 June 1931 Captain J. H. McNeile and I, with the same ship and captain, again left Norway for Spitsbergen. This time we were accompanied by D. G. MacInnes. Three days later drift-ice was entered in latitude 75° 20′ N., longitude 16° E., and pack-ice was encountered in 76° 10′ N., 15° 30′ E. Stor Fjord was seen to be filled with this pack, which extended round South Cape and up the west coast of Spitsbergen as far as Bell Sound.

Advent Bay was reached on the 14th. For the next ten days, with the exception of three days during which time they passed through Foreland Sound to Vogel Hook and returned, the expedition remained in Ice Fjord. Foreland Sound was free of ice. From the top of the highest peak of Vogel Hook, bright ice blink was seen above the whole of the northern horizon, but only a few small patches of ice were visible. Some of the bays on the north side of Ice Fjord were still blocked with land-fast ice.

During the 24th and 25th the expedition went to Liefde Bay. No ice was seen on the way, as there had previously been strong winds from the east and south. Liefde Bay was filled with drift-ice which was heavily packed at its southern end. This ice, it was said by two trappers, had only recently drifted into the bay, and there had been open water all the winter. The snow had barely commenced to go from Reindeer Peninsula. The ship remained in Liefde Bay until July 3, when she went to Wahlenberg Bay in Northeast Land. There was little ice in the northern part of Hinlopen Straits, but Wahlenberg Bay was blocked a short way inside the mouth. A landing was made on one of the two islands at the mouth. On the Admiralty Chart of 1913 these islands are marked as one, but are correctly shown on the 1931 edition. To the west of these islands was a very large stranded berg, which projected 200 feet above the water. The Alkrange on the west side of Hinlopen was then visited, after which a return was made to Liefde Bay. The ship remained here from the 5th until the 7th, when she went as far down Wijde Bay as Cape Petermann. Much ice, which was being driven out by the wind, was passed through near the mouth of the bay. Here all the snow was gone from the low ground and plant life was much more advanced.

On the 8th a return was made to Wahlenberg Bay. The ice was just breaking up sufficiently to let the ship enter Palander Bay. She was able to get a little farther into this bay than in the previous year. On the northern side of Palander Bay is a mountain of pale tawny coloured scree, having longitudinal streaks of black scree which give the impression of bright sunshine and shade. Much of the southern side of the bay is occupied by a large glacier, forming an ice-cliff at the sea. Eastward of this is an 1100-foot mountain.

On the 9th the expedition returned to Liefde Bay, where it remained until the 14th. Here we were most fortunate in finding a nest with two eggs of the knot. The southward voyage was commenced on the 14th, short calls being

made at Kings Bay and Green Harbour. Ice Fjord was left on the 16th and Tromsö was reached four days later.

The ice conditions of the two years made a striking contrast; in 1930 no pack-ice was seen until halfway between Great Island and White Island, while in 1931 the ship was delayed by ice before she reached Spitsbergen. In 1930 no especial note was made of the weather. From the 1931 notes it would appear that when the barometer is below 75·5 cm. the prevailing winds are from the north and east, and when it is above 75·5 cm. they are from the south and west. Bad weather generally comes from the north. The highest pressure registered by the barometer on the ship was 77·15 cm. on June 14 at Advent Bay, and the lowest was 74·4 cm. on July 11 at Liefde Bay during a snowstorm. The weather is very local, and the dividing line between calm and wind, or fog and sun, remains in the same place for a long time.

It is pleasing to learn that the efforts of the Norwegian Government to protect the reindeer of Spitsbergen are already bearing fruit. Thirteen different reindeer were seen in one day in Ice Fjord, and two others were seen on another day. On Reindeer Peninsula a herd of seventeen was seen, and later other ones, but these might have been already counted in the herd. Fresh tracks were plentiful at Palander Bay. Old horns, the relics of the countless herds of the past, were lying everywhere from Horn Sound to Great Island and Swedish Foreland.

The prospect of the walrus is not so bright. The shingle beaches of Great Island have the usual history of at least one gigantic massacre, when four ships killed sixteen hundred walrus at one time. Now, save in winter and early spring, these beaches are deserted; the walrus has been driven to Franz Josef Land. Even there he is still being killed at a rate out of all proportion to the rate of his breeding. Only one thing can save him; that is, for the Russian and Norwegian Governments to enforce a close season for the next ten years or longer, as seems fit, in the Franz Josef and Spitsbergen groups. Unfortunately they are not likely to do so.

Ice Bears are far less numerous than they used to be, but, their skins being of little value in the summer, they are not so harried by the hunting ships. Two bears were shot by the expedition: one on Great Island, the other on the ice of Northeast Land. The diminution of the bears has almost served to keep up the number of seals in spite of the vast numbers killed annually by man. Ringed Seals, Bearded Seals, and Harp Seals were seen by the expedition. Only a few "finner" whales were seen in Spitsbergen waters in 1930, and none in 1931. But when we were nearing the coast of Norway on the return voyage in 1931, we saw large numbers of "finners" and two Blue Whales.

REVIEWS

EUROPE

DARTMOOR IN ALL ITS MOODS. By Douglas Gordon. *London: John Murray* 1931. 8×5 *inches;* viii+336 *pages; illustrations.* 9*s*

In these days of holidays at home another book which describes the beauty and fascination of Dartmoor is welcome. Mr. Douglas Gordon has for many years resided within easy reach of its chief centres, and the result of his research is to be found in this very readable and informative volume. Though he disclaims its being in any sense a "Dartmoor encyclopedia or guide-book," most subjects are touched upon, and readers of varied interests will find something of value. He has much to tell us of the customs of the people and of their curious love for "swaling" or lighting heather-fires, in order, as they say, to provide fresh grass for pasturage. His account however leaves it clear that this custom is often anything but judicious, and that any patch of heather that will "run" is generally set alight. An interesting chapter is devoted to "mists and mires" and the toll of cattle that the bogs take. He considers the tract of country lying between the head-waters of the Dart and Tavy to be the loneliest in England to-day, and Fur Tor in the heart of it one of our most impressive hills.

The chief interest of the book however is in its detailed account of the bird life and fauna of the region, and there can be few books which deal with this subject in more detail or with fuller appreciation. Mr. Gordon appears to be a born naturalist, and any one who shares his tastes cannot fail to find much that will appeal to him. The concluding chapter gives a short account of Dartmoor flora, thus completing a most interesting and up-to-date account of Devon's great Moor.

A. W. S.

DAS ALPINE EUROPA UND SEIN RAHMEN: Ein geologisches Gestaltungsbild. By L. Kober. *Berlin: Borntraeger* 1931. 11×7 *inches;* 310 *pages; illustrations and maps. M.*20 (*paper*); *M.*22 (*bound*)

This volume is a natural complement to Kober's earlier work 'Bau und Entstehung der Alpen,' published in 1923. He now examines the whole belt of folding which runs through southern Europe, and throughout the belt he finds the same elements that he had recognized in the Alps; but there is great variation in their relative development. According to his views an orogenic belt is not formed by one part of the Earth's crust being pushed over another, but by the compression of a yielding part of the crust between two rigid areas, with overthrusting towards both. The belt is limited upon each side by a foreland, and each margin of the belt itself is constituted by a broad band in which there is overthrusting towards its own foreland. Between the two overthrust bands lies an intermediate zone in which block-faulting prevails. This zone, the "Zwischengebirge" of his earlier works, is here styled the Internides.

In the orogenic belt of southern Europe the ranges which look towards the main mass of the continent belong to the northern overthrust band, those which look towards Africa and Syria belong to the southern band. In both bands Prof. Kober recognizes zones corresponding with the Helvetian, Pennine, and East Alpine systems of nappes in the Alps. Each has special characters which distinguish it, and he traces the first and third throughout both bands, while the second, as in the Alps themselves, is less completely exposed to view. The intermediate, or Zwischengebirge, zone in the west of the region lies beneath the Mediterranean. It runs eastward from near the Straits of Gibraltar to the north

of Sicily, turns north between Italy and Sardinia, and disappears in the Gulf of Genoa. In the Alps it is absent, but it reappears as a wide area in the Hungarian plain. Thence it continues as a relatively narrow band through the Balkan peninsula, and widens again in Asia Minor between the Pontian ranges and the Taurus, passing onwards still farther into Asia. In the west of the area the northern overthrust band runs through the Sierra Nevada, the Balearic Islands, Sardinia, and Corsica; the southern band through the Atlas, Sicily, and the Apennines. The two bands come together in the Alps, the northern band constituting the greater part of the visible range. East of the Alps the northern band includes the Carpathians, the Balkans, and the Pontian ranges; the southern band runs down the west side of the Balkan peninsula into Asia Minor, where it includes the Taurus and other ranges. Crete and Cyprus also belong to this band. The Pyrenees in the west and the Caucasus in the east are offshoots from the northern band.

This is the framework of the whole edifice as seen by Kober. For the details and the evidence upon which he relies the reader must refer to the book itself. He will find, if he does not know already, that Prof. Kober is a remarkably lucid writer. Moreover he takes pains, with the help of illustrative maps and sections, to make his interpretation as clear as possible, and the three plates which accompany the volume form a very graphic representation of his general conclusions. He is not especially concerned in this volume with the actual causes of Earth movements, but he is one of those who think that though the contraction theory is old it is at least as good as any of the newer ones. P. L.

SÜDDEUTSCHLAND. By ROBERT GRADMANN. Vol. I. Allgemeiner Teil. 216 *pages*. Vol. II. Die einzelnen Landschaften. 554 *pages. Stuttgart: J. Engelhorns Nachf.* 1931. 9×7 *inches; illustrations and maps. M.*40 (*paper*), *M.*44 (*cloth*)

The author claims that with the exception of a small work by Norbert Krebs published in 1923 this is the first scientific work devoted specifically to the geography of South Germany, although of course the subject is dealt with at some length in important works on Germany as a whole, notably those of Professor Penck. The greater part of the book, that is to say the whole of the longer second volume of 554 pages, is devoted to individual studies of the geographical units that go to make up South Germany; for the author has found it impossible to discover much geographical unity in the area described under the title designation, although that area is geographically so sharply divided from the rest of the Reich.

Volume I, of 216 pages, deals with the general aspects of the subject in a number of sections covering land-forms and climate, flora and fauna, movement and settlement, land utilization ancient and modern, the development of towns and markets, the present distribution of population; and ends with a discussion of the spiritual and intellectual characteristics of the people. The author finds little to differentiate the folk of South Germany from their fellow countrymen of the north (p. 8), while a regional comparison of the two major areas of north and south is rendered impossible by the marked differences that distinguish the individual geographical units of South Germany from one another.

In each separate study in Volume II Professor Gradmann proceeds methodically to develop the various aspects of the regional geography, following the methods of the classical geographers from Ritter onwards. The account terminates in each instance with a "Landschaftsbild." This systematic treatment does not however prevent the author from expanding a theme of special interest and even from considerable digression where occasion invites. We may cite such

instances as the interesting discussions on the term Upper Rhine, on the origin of the Rhine Rift, on the hydrography of the Main and Neckar systems, on the effects of summer flooding in inducing the development of flood-plain forest, on the rise of the towns of the Alpine Foreland. Alsace and Lorraine continue to reap what is probably the one advantage of their borderland position—namely that of being the object of solicitous study on both sides of the frontier. These provinces will end by having the largest geographical literature in the world.

'Süddeutschland' forms a valuable source book. The text is larded with references, and it speaks highly for the clarity of the writing and the interest that the author arouses that the attention of the reader is held in spite of these incessant interruptions. There are fifty pages of references at the end of the book to testify to the author's erudition. One has to admit, while feeling that the work might with advantage have been lightened by the jettisoning of much of this over-conscientious citation, that most of it is justified in a critical examination of evidence. A number of useful maps illustrate definite problems (one would have been glad of as many more), but the reader who has not had access to large-scale maps, both orographical and geological, will often find it difficult to follow the more detailed accounts and arguments. The main regret one feels in reading this admirable descriptive analysis is that more space and attention was not given to the direct correlation of human, and more particularly economic, activities with the physical conditions. H. O.

WANDERINGS IN GREECE. By F. S. BURNELL. *London: Edward Arnold & Co.* 1931. 8×5 *inches; 254 pages; illustrations and sketch-maps.* 7*s* 6*d*

Mr. Burnell's new volume is a fitting companion to his earlier book on Rome. In a modest Foreword he pleads, as an excuse for yet another work on his subject, that no guide-book to Greece has been published in England since before the War; and further, that "to visit Greece with a guide-book as one's sole source of information is to miss at least half the interest of the country." His double aim therefore has been to cover and describe the usual routes, or less well-known places, while setting his readers, whether at home or actual travellers, in the atmosphere of the country's past.

The writer has studied his theme from all aspects, mythological, artistic, literary, and historical. His Bibliography shows the wide range of his scholarship, and each chapter proves how deeply he has entered into the Greek inspiration and way of life. In sketching his background of 'The Dawn in the Aegean,' he connects the half-mythical heroes who still sway our imagination with modern Greece by retelling the epic tale of Souli's defence of that mountain village against the Turkish soldiery in 1819; then takes us back to a pre-Hellenic time, when "the Aegean was already the home of a wonderful Bronze Age culture which radiated its influence from end to end of the Mediterranean."

With the Acropolis as centre, Mr. Burnell wanders in each direction; afterwards devoting a chapter to Eleusis and its mysteries. Corinth, the famous group of cities in the Argolid, Delphi, and Olympia, are all described with a wealth of memories and detail; and finally the reader is carried across the sea to Crete. There, at Knossos, the long labours of Sir Arthur Evans have uncovered the royal city of King Minos, and partially reconstructed his great palace; thereby tracing Mediterranean civilization back to its pre-historic source. The last chapter gives an admirable summary of the latest discoveries made in that treasure house of antiquity, which also revealed many anticipations of modern science, art, and domestic architecture. The excellent photographs of scenes and buildings in Greece, and of portions of the Minoan Palace, increase the interest and value of Mr. Burnell's book. M. K.

ARBEITEN DER ANSTALT FÜR HESSICHE LANDESFORSCHUNG an der Universität Giessen. Geographische Reihe. Edited by F. Klute. Nos. 1–6, 9, 11. *Giessen* 1930, 1931. 10×6 *inches; illustrations, maps, and diagrams*

Each of the first six parts deals with one of the six regions into which Hesse has been divided for the purpose of this detailed study; the divisions used are South-West and North-East Oberhessen, Northern and Southern Starkenburg, Northern and Southern Rheinhessen. The method employed is to utilize maps of the land valuation according to the assessments made in connection with a Land Tax Act of 1824 as bases on which to build; each part is the work of a different author, but the method of treatment is consistent throughout.

For each of the above areas two maps have been prepared, one showing the land values in black, and the other the regional boundaries, meadow land, arable land, parish boundaries, and place-names superimposed in black on the land values, here reproduced in blue. The geology, physical features, climate, and vegetation are each considered in turn, while dot maps are reproduced for the chief grain crops (1927) for each part. These dot maps would have been greatly improved had the authors used some symbol other than a dot for the site of towns. Statistics are quoted to indicate trends in the branches of agriculture concerned, and at the conclusion of each part there is a complete list of parishes with the respective areas of arable land, meadow, and waste, the amount of land included in each class of valuation under the Act, and the total area agriculturally developable: in addition the vineyard area is included in the tables for Rheinhessen. In the long lists of references some indication of the more useful works would be acceptable. In addition to the facts common to all six parts, the treatment of Rheinhessen includes material and maps concerning historical distributions, some of an archaeological nature.

Part 9 deals with population in Rheinhessen, beginning with a treatment of the following four groups: land, industrial, commercial, and other occupations. Tabulated statistics are included at the conclusion of this part and include a complete table, parish by parish, of persons occupied in various branches of the above four groups of occupations for Rheinhessen. Part 11 deals with the development of three towns to the north and west of Giessen: Wetzlar, Herborn, and Dillenburg; and includes a set of maps showing the growth of the sites and illustrating the range of influence of the several places as market centres—an idea which is being developed in a number of cases in this country at the present time.

It is satisfactory, but unusual, to find so much of the raw material on which the authors base their conclusions actually submitted to the reader, and we are grateful to all concerned for the thorough and exhaustive treatment which one has come to expect from the German school of geographical research workers. H. C. K. H.

LA PORTE DE BOURGOGNE ET D'ALSACE. By André Gibert. *Paris: Armand Colin* (1930). 10×7 *inches;* xiv+638 *pages; maps.* 80 *fr*

M. Gibert offers us an analysis of the function of the Gate of Burgundy rather than a regional study. Nevertheless, the first book, of 190 pages, is devoted to a consideration of the physical conditions of structure and relief, climate, hydrography, and vegetation. M. Gibert has not confined his study to the gap itself, but has included the surrounding *terrain* and deals with the Rhine depression as far north as Mulhouse, the Sundgau, and the Montbéliard district, the Oignon valley, and the edge of the Bressane basin.

Book Two concerns the inter-relations, under past and present conditions, of lands on either side of the gap. The author traces the geographical conse-

quences of political changes from the earliest times, as shown in types of settlement and language distribution. He then proceeds to treat of the commercial value of the gate, and one gathers that, in his opinion, the importance of the gap as a great international passage way has been exaggerated. Before the modern road and railway, forest, marsh, and highwaymen made the passage as difficult for pack-horse traffic as the mountain ways (p. 288), while political conditions discouraged its utilization. The rival routes through Lorraine to Frankfurt and Cologne and over the Alpine *cols* to upper Alsace seem to have been able to command most of the international traffic, leaving to the Belfort Gap a regional commercial importance only. This curious neglect of a natural routeway is attributed by the author largely to the vexatious obstruction carried on by the county of Montbéliard, through which ran the original route. Owing to the semi-independence of the territories of the passage-way and the inhibiting effect of local customs barriers, the gap never came into full use until its territories were incorporated within France. Much was hoped for from the construction of the Rhine–Rhône canal, but it was not till the railways were carried through that the gap can be said to have had great international importance, and even to-day it has a political rather than an economic significance.

In Book Three the author proceeds to show what the territory of the gap stands for in an economic sense. He traces the historical exploitation of the land for agricultural purposes down to the present day and shows how, down to the French Revolution, rural life turned in a narrow circle without ambition or resources. There is an interesting chapter on the rural habitat. Rural life took no note of the through route. The village sites depended on local industrial facilities, on defensible positions, and later on proximity to the better soils. The author marks a change in the type of rural housing as one passes from west to east, from the stone houses of the Jura and Vosges, adapted to hard winters, to the timbered houses of the Sundgau and the upper Alsace.

Book Four deals with the industrial evolution, particularly that of the ancient iron and textile industries, which is traced down to the present day. The author admits that there is no continuance of industrial development linking the Mulhouse district with the industrial centres of Montbéliard and Belfort, but implies that with the return of Alsace to France there is a tendency towards the formation of a single industrial group. The three centres are however closely related from the point of view of power supply. The great electrical installations of Ronchamp and Mulhouse supplement one another and the power generated by the Doubs. The modern development of Belfort is attributed largely by the author to the convergence of railways in the gap. H. O.

DIE GEOGRAPHISCHEN GEBIETE FINNLANDS. Eine vergleichende Übersicht nebst methodischen Erörterungen. By J. G. Granö. Publicationes Instituti Geographici Imiversitatis Aboensis, No. 6. *Helsinki* (1931). 10×7 *inches;* 182 *pages; illustrations and maps*

This volume of Professor Granö's, accompanied by its beautiful maps, represents a highly finished piece of exact and unified research extending over a wide area. Probably nowhere else in the world has a country of such great extent been mapped out in so precise and individual a manner.

For the purpose of assembling and comparing the actual physical data throughout the region, Professor Granö has made use of the method which he devised originally in Estonia, by which the features represented in the various types of scenery in a country of this kind can be categorically arranged and tabulated. A description of these features occupies the first seven chapters of the book, being illustrated by the coloured maps which accompany it. In the eighth chapter the

variable features in the landscape are dealt with, these being contrasted with the permanent ones already given. The four remaining chapters are concerned principally with the human geography of the region, full information being given about the population, agricultural activities, livestock farming, and other industries, and include many useful charts relating to the amount and distribution of each. In addition the remarkable availability of hydro-electric energy, due to the somewhat peculiar land-conformation, is fully explained and illustrated.

As a thorough and reliable study of a new country undergoing rapid development, the work is both informative and stimulating. E. G. W.

ASIA

THE ROMANCE OF THE INDIAN FRONTIERS. By Lieut.-Gen. Sir GEORGE MACMUNN. *London: Jonathan Cape* 1931. 9×6 *inches;* 352 *pages; illustrations and maps.* 16*s*

THE FRONTIER PEOPLES OF INDIA: A Missionary Survey. By ALEXANDER MCLEISH. *London: World Dominion Press* 1931. 10×6 *inches;* vi+202 *pages; illustrations and maps.* 5*s*

Both these books are of considerable geographical interest and cover the same ground, except that the former stops at the Brahmaputra, while the latter deals also with the frontier of Burma. The differences of treatment are determined by the point of view of the author. General MacMunn's object is "to see the frontiers through the ages with all their romance." Mr. McLeish's book is primarily a survey of missionary effort among the borderland peoples of India proper. They both deal with a region almost entirely mountainous, with an area four or five times that of Great Britain, and on the whole very sparsely populated. But it is rightly observed that the figure representing the density of population to the square mile of such regions conveys a false impression. To say that the Chagai district has a population of one to the square mile merely indicates that this is an area with an exceptionally small population. A truer view is given by the density on the actually inhabited or cultivated area, and this may be astonishingly different, as it is in Kashmir, from the average density of the country as a whole.

General MacMunn deals more with history and adventure. He has the advantage of long personal experience on the North-West Frontier, as well as an exciting early experience on the North-East Frontier, so that by far the greater part of his book is concerned with the history, peoples, personalities, invasions through, and campaigns in, the North-West Frontier, from the coming of the Aryans to Amanulla's futile invasion of India in 1919, and the subsequent frontier disturbances. He is a lively writer, fond of quotation, but his opulence of style is not always consistent with accuracy. He says, "As we pass down the eastern plains we shall see the twin peaks, where rise Jamna and Ganga, great snowy breasts like towers, that men call Jamnotri and Gamnotri, kissed by the clouds, since man cannot venture." But Jamnotri is a sacred shrine near the head of the Jamna, and Gangotri (not Gamnotri) is a sacred shrine on the Bhagirathi, some miles below its source in the Gaumukh glacier. He has two chapters devoted to tales, and here he is perhaps at his best.

Mr. McLeish describes successively the borderland states and districts from Baluchistan to the Sadiya Frontier Tracts, assigning a fairly proportioned amount of space to each. He gives much interesting information, from sources new and old. But, as geography, the treatment is not systematic. The description of Chamba State is one of the best. Here we have the matter arranged under

specific headings: the Land, Geology, Flora and Fauna, History, the People, Language, Missionary Work, and this is the only instance in which the geology of the area described is definitely referred to. Nepal, no doubt for good reasons, has more history than geography, and when we come to Bhutan geography is at its minimum, the bulk of the chapter being taken up by an account of a visit to Panakha for the enthronement of the present Maharaja.

Mr. McLeish has three main divisions: the frontier from Baluchistan to Kashmir and Jummu, which, with the exception of Buddhist Ladakh, is predominantly Muslim; the Hindu-Buddhist frontier, from Chamba to Almora, which is predominantly Hindu; the Buddhist–Hindu frontier from Nepal to the Sadiya Frontier Tracts, which is mainly Buddhist, though the people of the Balipara and Sadiya Frontier Tracts are Animists. The obstacles to missionary effort in these frontier lands are frankly stated. They are, first, the difficulties special to the areas to be attacked. In Baluchistan, if a Muslim patient at one of the missionary hospitals in British Baluchistan (and there are none elsewhere) "becomes convinced of the truth of Christianity, the price of open confession is almost certainly death." The wilder parts of the North-West Frontier Province are practically inaccessible to non-officials. In Tehri and Garhwal, full of sacred sites associated with Hindu mythology, the atmosphere is essentially hostile. In Nepal Christians are not allowed. Bhutan is still practically a closed land, and those who enter the Frontier Tracts take their lives in their hands. And, secondly, as Mr. McLeish confesses, the labourers are too few, and are ill organized. He is not too hopeful for the future. But here, as always, medical missions are doing beneficent work and are advancing civilization.

In both books there is evidence of the results of modern road-making in Baluchistan and the North-West Frontier Province. In Baluchistan the old international route along the Mekram coast is in disuse, and the modern roads tend to link up the country with Quetta and its railway connections with India, and with the line from Spezand to Duzdap, inside the Persian frontier, which provides a modern route for international trade. In the North-West Frontier Province motor roads have been made connecting the hinterland with railheads and military centres, with the same object as General Wade's roads in the Scottish Highlands in the eighteenth century, and with the same results—the gradual pacification of the country, and its linking up with civilization.

The picturesque little state of Chamba and its neighbours afford interesting examples of the geographic control of the distribution of languages, races, and religions. Chamba, hemmed in by mountains, stopped Muslim advance from the west, and is a relic of the Hindu past, a storehouse of Hindu antiquities invaluable to the student of India's ancient history. Chamba proper, the basin of the Upper Ravi, has the Dhauladhar range in the south, crossed by high passes leading from the Kangra valley of the Punjab. Through the State, north of the capital, runs the Pir Panjal range, separating the basins of the Ravi and the Chenab, while along the northern border runs the Great Himalaya (not, as Mr. McLeish says, the Zanskar range). Continuous on the east with Chamba is Lahul, the country of the upper Chenab and its head streams, the Chandra and Bhaga. Lahul, hemmed in between Ladakh, Chamba, and Kulu, the basin of the upper Beas, has been subjected to multifarious influences which it expresses in its mixtures of race, religion, and language. Hinduism has prevailed in the valley of the Chenab, but Buddhism remains in the basin of its head streams. By the Rohtang pass over the Pir Panjal, Lahul is in contact with the primitive Hinduism of Kulu; by the Baralacha pass over the Great Himalaya into Ladahk and by the Kanzam pass over the Great Himalaya into Spiti it is in contact with unadulterated Buddhism. Farther south-east Hinduism has passed the Great

Himalayas in the valley of the Sutlej, and Buddhism is not found until we reach the Shipki pass in the Zaskar range.

The maps in General MacMunn's book are clear and adequate. The maps in Mr. McLeish's book show clearly the areas described, but the mountains are sketchily depicted. Both books have excellent illustrations. W. H. A. W.

INDIA AND JAMBU ISLAND. By AMARNATH DAS. *Calcutta: The Book Company* 1931. 9×6 *inches;* vi+344 *pages; illustrations and maps. Rs.*12.8

In his introduction the author describes his object as being "to trace as far as possible the remarkable changes that have taken place in the configuration of India during the course of the last twenty centuries." The very remarkable nature of these fancied changes will be seen from some of the conclusions which the writer has come to, as, for example, that in the second century A.D. Southern India (meaning roughly the Deccan, as will be seen from the sketch on p. 45) was an island called Taprobane, which was separated from the mainland (meaning India north of the Deccan) by a shallow sea that stretched from what is now the Gulf of Cambay eastwards to the Bay of Bengal in the vicinity of the present Vizagapatam district; that the Ganges flowed southwards from near Benares, through the Palamau district and the highlands of Chota Nagpur, and so on through the Mayurbhanj State into the sea; that the Nerbudda flowed southwards from a point near Chandgarh, and "penetrating the Satpura range" joined the Tapti, which it "crossed," and then flowed past Chalisgaon and Sangamner, thereafter dividing into three branches which fell into the sea near Kalyan, Bombay, and Barsi respectively; and so on, other rivers performing similar strange feats. It is only necessary to look at a contour map of India and at geological maps of the areas concerned—not to speak of the epigraphical and documentary evidence of conditions in the second century A.D. that we possess —to realize the absurdity of such speculations. In support of these and other suggestions of similar nature, identifications of towns and ports named by Ptolemy have been proposed which cannot be treated seriously.

C. E. A. W. O.

AFRICA

THE BANTU TRIBES OF SOUTH AFRICA: reproductions of photographic studies. By A. M. DUGGAN-CRONIN. *Cambridge: Deighton, Bell & Co.* 11×8 *inches.*

Vol. I, Section I, Plates I–XX. The Bavenda, with an introductory article on the Bavenda and descriptive notes on the plates, by G. P. LESTRADE. 1928. 24+xx *pages.* 15*s*

Vol. II, Section I, Plates I–XXVI. The Suto-Chuana Tribes, Sub-Group I, The Bechuana; with introductory articles on the Suto-Chuana Tribes and the Bechuana, by G. P. LESTRADE. 1929. 24+xxvi *pages.* 21*s*

Vol. II, Section II, Plates XXVII–LII. The Suto-Chuana Tribes, Sub-Group II, The Bapedi (Transvaal Basotho), with an introductory article on the Bapedi and descriptive notes on the plates, by WERNER EISELEN. 1931. 16+xxvi *pages.* 21*s*

These volumes, originally issued by the Alexander McGregor Memorial Museum of Kimberley, consist of photographic studies by Mr. Duggan-Cronin of three of the most important of the Suto-Chuana tribes (the central group of the South African Bantu), with descriptive notes and short introductory chapters by Mr. G. P. Lestrade and Dr. Werner Eiselen. Mr. Duggan-Cronin has employed his leisure for over twenty years in obtaining a comprehensive series of pictures of

native life. The result is a valuable pictorial record of costume, technology, and mode of life, to which Mr. Lestrade and Dr. Eiselen have supplied, though all too briefly, the necessary historical and cultural background.

To the ethnologist the plates showing physical types are of special value; the interest and importance of knowing what such men as Sekukuni II looked like will enormously increase with years. In a minor degree this no doubt holds of the photographs of village scenes and groups, but, technically perfect though these be, the reviewer could not help sighing for at any rate some plates less static in character, while from the scientific standpoint, and especially from the point of view of future generations, it seems a pity that Mr. Duggan-Cronin has not included "snapshots" of phases of tribal ceremonies, particularly sacrificial and funeral rites, for which his evident knowledge of and sympathy with the natives must have afforded him opportunity. If this is not a counsel of perfection, he might perhaps do so in a future publication. C. G. S.

MONUMENTA CARTOGRAPHICA AFRICAE ET AEGYPTI. By YOUSSOUF KAMAL. Tome Troisième. (Époque Arabe) Fasicule I. 1930. 30 × 24 *inches; folios* 481–582.

YOUSSOUF KAMAL. Monumenta Cartographica Africae et Aegypti. Notice. I^er^ Fasc., T. III. (1931). 12 × 9 *inches; 12 pages*

Tome I and Tome II, Volume I, of Prince Youssouf Kamal's sumptuous collection of primary sources for the historical cartography of Africa have been already reviewed in the *Journal* (vol. 73, p. 549), and it is therefore unnecessary to remark upon the general scope of the work, or upon the system of compilation. Tome II, Volume I, dealt with the first centuries of the Greco-Roman period, and it is understood that this Tome will be completed in two further volumes, which will carry the survey to the invasion of Africa by the Arabs, that is, to 650 A.D. approximately.

The volume at present under review is Volume I of Tome III, covering the first three centuries of the Arab period. Further volumes will bring it down to the commencement of the Portuguese discoveries in the fifteenth century.

This volume falls naturally into two parts, the series of excerpts from the Arab geographers and chroniclers, illustrated largely by cartographic reconstructions of various dates, and the series of reproductions of mediaeval "world-maps," based almost entirely upon theological conceptions, and rarely recording the results of first-hand observation.

The Oriental materials, notwithstanding their prominence in this volume, are on the whole slight. The greater part consists of texts from the earlier Arabic descriptive geographers, with references of geographical import contained in historical traditions, poems, and papyri. The latter are naturally scrappy, though a praiseworthy attempt has been made to assign every historical tradition to its proper period by analysis of the sources. The former also are brief and unsatisfying, since by the year (950) at which this volume closes none of the great Arabic works of descriptive geography had yet been issued. Of the scientific geographers however the period includes the great Khwarizmi, and his Nile-map (from a MS. of 1037) is the only original Arabic map which the volume contains. The remaining "Arabic" maps are reconstructions of Arabic maps by modern scholars—some of them, such as Lelewel's reconstruction of the Map of Al-Ma'mun, of very doubtful value. The other Khwarizmi map reproduced is von Mžik's careful reconstruction of his map of Africa. As this differs in details from the original Nile-map immediately preceding it, a rendering of the Arabic map itself into Latin characters would have added greatly to the value of this collection. A more heterogeneous element is introduced by the numerous maps

of political geography at various dates. The unsystematic way in which the selection has been made (merely from what the editor found ready to hand) contrasts unfavourably with the comprehensive ideal of the work on its geographical side.

The special feature, from the point of view of the general student of historical geography, is the very comprehensive series of reproductions of mediaeval world-maps. In making this selection Dr. F. C. Wieder, who is associated with Prince Youssouf Kamal in editing this work, was deeply indebted to the generosity of Mr. Michael C. Andrews in placing at his disposal his great collection of photographs of mediaeval maps, the result of many years' research. The final volume of the 'Monumenta' is to contain details regarding its composition, the researches involved, and the assistance received from collaborators. Since however Mr. Andrews has in the press a volume which treats systematically of these world-maps, Dr. Wieder is anxious to anticipate his acknowledgment of Mr. Andrews's help, and to secure for it the widest publicity.

The important item in this volume is a world map, now preserved at the Vatican, which has previously been unknown. It dates approximately from 850 A.D., and its interest lies in the extent to which it anticipates the so-called Anglo-Saxon world-map of the tenth century (B.M. Cotton Tiberius). This evidence of the continuity of cartographic ideas throughout the Middle Ages, with an increasing conventionality of execution, is further illustrated by another plate reproducing folios from a ninth-century MS. of the 'Agrimensores Veteres Romanorum.' This collection embodies the work of land surveyors of the fifth century. The two maps reproduced are of areas in the Romagna and Campania, the latter depicting the lower course of the river Liris around Minturnae—the modern Trajetto. Two points are noteworthy: these must be the earliest surviving attempts at regional survey, and secondly, the cartographic conventions employed are striking. It is still an unsettled question whether the extant Ptolemy MSS. are lineal descendants of maps drawn by Ptolemy himself, or whether they were compiled by map makers from the data supplied by him. Schütte has argued that they were drawn by Ptolemy, or at least by contemporaries of his, asserting that the MS. maps are in a style, though somewhat degraded, which must have originated early in the Christian era. The most characteristic feature is the method of representing mountains. The problem is to trace back this convention. Schütte supported his case by the cartographic style of, among others, the Madaba mosaic map of the seventh century and the Beatus world map of the tenth. Turning to these maps from the 'Agrimensores' we observe at once that they are executed in a similar style to the earliest Ptolemy MSS., but in a less conventionalized manner. They therefore support Schütte's arguments, and it seems certain that the surviving Ptolemy MSS. are the latest in a line of high antiquity.

H. A. R. G.
G. R. C.

ROCK-PAINTINGS IN SOUTH AFRICA . . . copied by GEORGE WILLIAM STOW; with an Introduction and Descriptive Notes by DOROTHEA F. BLEEK. *London: Methuen & Co.* 1930. 13 × 10 *inches;* xxviii + [144] *pages; illustrations and map.* 42*s*

BUSHMAN ART: ROCK PAINTINGS OF SOUTH-WEST AFRICA. By HUGO OBERMAIER and HERBERT KÜHN. *London: Humphrey Milford* 1930. 14 × 10 *inches;* xii + 70 + [78] *pages; illustrations.* 4 *guineas*

Testimony to the increasing interest which has been aroused in the graphic art of the Bushmen of South Africa is afforded by the publication almost simultaneously, in 1930, of these two splendid and elaborately illustrated volumes, both of

them most welcome accessions to the growing literature of the subject. The two works by different authors, in spite of their close similarity in subject and in "make up," are not to be regarded as rival volumes. They rather supplement each other, and each tends to render the other indispensable for comparative study of Bushman art phenomena. Miss Bleek's principal object has been to render accessible, by facsimiles, a large number of the copies in colour of Bushman rock-paintings which were made by the late George William Stow in the Eastern Province of Cape Colony and in the Orange Free State, between 1867 and 1882, working under considerable difficulties in the course of trading expeditions or geological survey work. When Stow died, in 1882, his sketches were purchased by Miss L. C. Lloyd, one of the great authorities upon Bushman lore, who desired to publish them, but was prevented by lack of funds. She bequeathed the collection to Miss Bleek, who, with the generous assistance of the Carnegie Trustees, has now made available to all seventy-four of these copies in a very attractive book. Before doing so she endeavoured to visit the original rock-paintings *in situ*, and was successful in locating and seeing sixty of them. By this means she has been able to append her own comments to Stow's descriptions of the paintings, and to note and record such changes as have occurred since Stow's time, through weathering, fading, vandalism, and other destructive agencies. Her comments show only too clearly how urgent is the need of faithful records of these fast-vanishing remains of the artistry of a recent palaeolithic people.

On the debated point whether the Bushmen were in truth the artists responsible for the South African rock-pictures, Miss Bleek argues strongly in favour of this view. But, unlike most archaeologists and ethnologists, she does not endorse the view that a magical incentive was the chief stimulus in the development of the realistic portrayal of animals, etc., and urges a more purely aesthetic impulse. Herein there will be much disagreement with her diagnosis of the *raison d'être* of this school of primitive art. This valuable and attractive book does great credit to herself as well as to the original copyist, Stow.

The second work under review, by the joint authors, Professors Hugo Obermaier and Herbert Kühn, is an equally fine publication of high scientific importance. Its chief object is to record a number of hitherto unrecorded Bushman paintings from South-West Africa (Damaraland and Great Namaqualand), which were photographed or copied very faithfully by Reinhard Maack, a surveyor. Apart from the fine series of very instructive pictures, beautifully reproduced, the book gains much importance from the letterpress, in which the authors, in a series of chapters, each with bibliographic references, give a résumé of what is known in regard to the graphic art of the Bushman, together with a summary of the South African Stone-age sequences as so far diagnosed. Their comparison of this south-western "school of art" with that of the areas farther to the east is of interest, the authors pointing out certain differentiating peculiarities and characters. The renderings of the former "school" are more strictly "two-dimensional" and exhibit a more dominant emphasis upon composition, often at the expense of realism. The very striking resemblance which exists between the Bushman art and the prehistoric art of the eastern area of the Iberian Peninsula, with the intriguing ethnological affinities which it suggests, are dealt with by Professor Obermaier in a masterly manner with true scientific caution and reserve—a valuable check upon the somewhat exuberant assumptions which have from time to time been put forward with undue confidence. Further research will be needed before the ethnological problems of this fascinating chapter in human geography will be authoritatively solved, and, in the meantime, the judicial summing-up of the evidence at present available and of views already expressed, will militate against the drawing of too hasty deductions.

The dual authorship has certain disadvantages, even where both authors are archaeologists of the first rank. The opinions expressed independently do not always harmonize completely and slight confusions arise. The trend of some of the arguments is occasionally obscured, owing to the involved and sometimes rather ponderous literary style. But one hesitates to criticize minor points in a book which should be hailed with enthusiasm and with a feeling of gratitude to the authors and the publishers.

In these hard times one cannot fail to notice that of two very similar books the one containing nearly twice as many plates is only half as expensive as the other.

H. B.

NORTH AMERICA

A CANADIAN GEOLOGIST: (J. B. Tyrrell). By W. J. Loudon. *Toronto (and London): The Macmillan Co.* 1930. 9×6 *inches;* viii+258 *pages; portrait.* 10*s* 6*d*

Mr. J. B. Tyrrell, the subject of this short biography, now lives in retirement; but he can look back to a life filled with adventure and interest whether in sub-Arctic exploration or in the development of Canadian mining. To geographers his most interesting trip was his first journey by canoe in 1893 across the Barren Lands west of Hudson Bay. He was forced to live on the land, and at once realized the advantages of what might at that time have been considered a hardship. It was on this journey also that Tyrrell and his brother discovered an Eskimo tribe of inland habits, who have since been very closely studied by Rasmussen as evidence of the early history of the Eskimo race.

Some years previously, and while still under training on the Canadian Survey, Tyrrell worked under Dawson in mapping the Crow's Nest Pass route across the Rockies; and we read that part of his share of the work in 1883 was to make a pace survey over the whole route, counting each step taken, and multiplying this number by the average length of step. During the Klondyke gold rush Tyrrell was sent to Dawson City to prepare official reports: next year he resigned from the Canadian Survey and set up as a consulting mining engineer in the Yukon Territory. This work became the central feature of his life, and the chapter describing these seven years' pioneering in the Klondyke is among the best in the book.

J. M. W.

CENTRAL AND SOUTH AMERICA

MODERN SOUTH AMERICA. By C. W. Domville Fife. *London: Seeley, Service & Co.* 1931. 9×6 *inches;* 320 *pages; illustrations and map.* 21*s*

This book is written in the easy informative style of the practised journalist. Though special attention is given to the picturesque in scenery, social life, and historical incidents, the solid material of the economic background is not neglected. Mr. Domville Fife has a flair for topics of interest and a way of quoting facts and figures that gives an air of mastery. His 'Modern South America' is very readable: it is light, but cannot be dismissed as superficial, for it shows an understanding of the peoples and of the background of their lives. Even the more serious student of South American geography and economic conditions may well be able to fill in from this book gaps in his knowledge, though he will probably find the descriptions of scenery somewhat over-coloured and the choice of places and subjects dealt with, distinctly the haphazard one of the butterfly attracted hither and thither by the gayest flowers. The full writer must needs make some selection, and the question arises upon what principle the selection is to be made. The well-informed journalist instinctively proceeds according to

the test of maximum general interest, and subordinates the scientific to the romantic. Mr. Domville Fife has gilded the pill of the former with a liberal coating of the latter. E. W. S.

AUSTRALASIA AND PACIFIC

SOUTH AUSTRALIA: a Geographical Study. By CHARLES FENNER. *Melbourne: Whitcombe and Tombs* (1931). 9×6 *inches;* xvi+352 *pages; illustrations and maps.* 7*s* 6*d*

This is a sound geographical study of a limited and mainly arid area. It is sufficiently exhaustive and gives a clear picture of the structure, the climatic conditions, and the human geography of South Australia. The author is fortunate in having as the subject of his study an area of which the essential part is reasonably compact, and yet shows considerable diversity of easily distinguished features. He has thus been able to keep attention clearly focussed while finding suitable opportunities of illustrating various geographical types.

The book is subdivided into five main sections, of which the second, which deals fully with the structure and physiography, is perhaps the best, though the last on the natural regions of South Australia contains some valuable summary material. A strong feature of the monograph is the illustrations and maps, numbering 153 in all. The sketch-maps well serve their purpose of adding clarity to the text matter, more especially those of the multiple type designed to show processes of development or the analysis of complex combinations into their superimposed components. The photographic illustrations are so chosen as not only to enable the reader to visualize the landscape but also, as Mr. Fenner suggests in his preface, to provide "documentary evidence." The book, if not very strongly bound, is well printed and reasonably priced, and is a credit to its Australian author and publishers. E. W. S.

THE ISLAND BUILDERS OF THE PACIFIC. By WALTER G. IVENS. *London: Seeley, Service & Co.* 1930. 9×6 *inches;* 308 *pages; illustrations and maps.* 21*s*

The researches detailed by Mr. W. G. Ivens in this volume were carried out on behalf of the University of Melbourne and under the auspices of the National Research Council of Australia. His objective was a detailed study of the Lau people of the coastal region of the northern part of Big Mala (or Malaita) in the Solomon Islands; and, in particular, he desired to investigate the life and habits of those whose peculiar habit it is to build their villages upon *artificially constructed* islands. The existing theories as to the original reasons for this practice—(1) that the islands were constructed as refuges from raids by the hill people, (2) that they were adopted as a means of avoiding the mosquitoes and sand-flies of the mangrove-bordered foreshore—are not accepted by the author, who favours the idea that the island villages function mainly as a means of keeping the fishing population near the market-places along the coast, where the products of the sea are bartered for *taro* and other produce of the hills.

The islands are built with blocks of coral, which are floated upon rafts to the selected shallow spot in the lagoon, and are there deposited. By accumulation the mass eventually is reared well above high-water level, forming a raised coral platform whose surface is levelled with sand. At first a new island is only large enough to accommodate three huts, the minimum requirement being a *beu*, or assembly hut for the men, a *luma*, or dwelling for wife and family, and an *obala*, or canoe- and working-shed. Subsequently the area of the island is extended and a small village is erected upon it. Sulu Vou, an island with the largest population

(300), measures 290 yards in circumference and is occupied by four families, each of which has a special landing-place. Open spaces are reserved as dance- and play-grounds. Coconut palms and a few other trees grow on the islands. Mr. Ivens gives a detailed account of the inhabitants of these man-made islets, their social organization, beliefs, industrial life, and so on, and his description is of considerable anthropological interest. He compares their habits with those of the hill natives, whose forested environment, with its lower temperature and perpetual fog or rain, imposes entirely different conditions. The hill people depend chiefly upon *taro* for their food supply, their diet being varied by fish obtained from the coastal folk. Though inferior to the latter in physique and mentality, they excel in artistic work and exhibit great skill in decorative technique of various kinds.

The book is well illustrated and is very readable. As a scientific treatise it is marred by a certain discursiveness and by constant references to porpoises as "fish," but these and other minor blemishes detract but little from the value of the book as a record of Melanesian natives living under special conditions of considerable interest. H. B.

PHYSICAL AND BIOLOGICAL GEOGRAPHY

PROBLEME DER WASSERWELLEN. By H. THORADE. (Probleme der Kosmischen Physik. Edited by C. JENSEN and A. SCHWASSMANN. XIII and XIV.) *Hamburg: Henri Grand* 1931. 9×6 *inches;* viii+220 *pages; illustrations and maps. M.*20

Dr. Thorade attributes the gulf which exists between theory and observation in the hydrodynamics of water waves to the fact that the mathematician confines himself to the theoretical side of the question and states the results of his calculations in symbols which scare off the practical observer, who fails to learn on what points further data are wanted. This book is intended to show where investigation is required. The author proposes a subject, shows how it has been treated in the past, compares the results of calculation and observation, points out discrepancies, suggests one or more problems for solution, and finally provides suggestions and weapons for their attack. Among the most useful of the weapons is the bibliography, from Leonardo da Vinci and Newton to the year 1930, with 329 references, of which 126 are marked with an asterisk to show that they demand more than elementary mathematical knowledge. The names of Lamb and Krümmel stand alone at the head of the list; it is to be hoped that the omission of an asterisk from the former will not lead to disappointment. The author refers the reader to the standard treatises, such as those of Lamb, Krümmel, and Graf Larisch, for the general theory, and gives only three pages to the fundamentals of hydrodynamics and five to the definition of the various kinds of waves.

All kinds of waves, from capillary waves and internal waves to the tidal wave, are then treated in more detail under two main heads: surface waves, the length of which is small compared with the depth of water, and "Flutwellen," the length of which is relatively great. As each kind of wave is discussed its mathematical treatment is more fully developed but still in an elementary way, except in some few cases where the general treatises fail and a more advanced treatment becomes necessary. In this connection it may be said that if the book appeared in its own bibliography it should be with an asterisk, though perhaps a small one. The 110 figures are very clearly drawn on eleven plates which are bound up at the end in such a way that they can be easily consulted together with any page in the text. There are also four maps and five photographs. The book should prove very useful for general reference as well as for its original purpose. D. J. M.

HANDBUCH DER KLIMATOLOGIE in fünf Bänden. Edited by W. KÖPPEN and R. GEIGER. Band II, Teil G. Klimakunde von Südamerika. By Professor Dr. K. KNOCH. *Berlin: Borntraeger* 1930. viii+350 *pages; diagrams and maps*

This is the third part of the 'Handbuch' to appear but the first to deal with the climate of a continent. In the completeness of its descriptive text, in the fullness of its tabulation of data, and in its exhaustive bibliography it sets a high standard which, if followed in succeeding contributions, will place the whole work upon that level of scholarship which was occupied by Hann's great contribution to descriptive climatology and to which, in spirit, it owes so much.

Approximately a third of the book is concerned with a presentation of the factors and elements in the climate of South America as a continent. While the text of this section is extraordinarily complete there are certain features in the cartographical presentation of the elements—particularly temperature and rainfall—which call for comment. The maps employed are on such a small scale (rainfall approximately 1/50 M., temperature 1/65 M.) that so soon as either element shows rapid regional variation, as in the Cordilleran areas, the maps become virtually illegible owing to the crowding of the isopleths. Further, while the bi-monthly maps of temperature and rainfall (for January, March, May, etc.) mark an advance both in accuracy and in fullness of representation of these elements, they nevertheless fall short of adequacy in the delineation of the régime of either; and in this connection it appears unfortunate that no recourse was had to the technique adopted in Dr. Franzes's admirable and graphic maps of temperature and rainfall distribution ("Eine karte des Temperaturverlaufs in Südamerika," *Pet. Mitt.*, No. 62, pp. 132–135, 1929; and "Die Niederschlagsverhältnisse in Südamerika," *Pet. Mitt.*, Supp. No. 193, Gotha, 1927).

The climatic descriptions, occupying some 150 pages, are organized primarily on the basis of political units—a method which, while consistent with the organization of the available data, is nevertheless frequently disruptive of that sense of the continuity of a climatic type which it is desirable to emphasize. Within each unit the attitude toward a subdivision into climatic regions is frankly opportunist and controlled solely by pre-existing work. Thus, in Colombia the regions discussed have a topographic basis; in Brazil—following the regions of H. Morize—a more purely climatological basis prevails. Even in Chile, an area upon which Professor Knoch is a first-rate authority, the division adopted is that of K. Martin (1889), and this in spite of the fact that Martin's divisions will not bear scrutiny either in respect of their homogeneity or of the limits assigned to them. Herein lies the key to the most serious defect of this monograph. In bringing together a vast bulk of knowledge it has done great service, but it has contributed nothing to the technique or to the philosophy of climatology. Even more, in the labour of painstaking summary the author seems to have lost all individuality. Nor does the contribution, by the senior Editor, of a map of Köppen's climatic regions and a three-page description of it, serve to give unity or an objective to the work. For the map, unmentioned elsewhere in the text, comes upon the reader as an ill-considered afterthought or as a belated concession to editorial importunity.

As will be expected from the foregoing paragraph the climatic descriptions both in method and in scope vary directly with the nature and volume of the literature at the author's disposal—and on any other than these purely practical considerations it would be difficult to defend the devotion of more space to the island of Juan Fernandez than to either Dutch or French Guiana. But apart from these points and from certain anomalies in Köppen's map of climatic regions the work remains one of outstanding importance and merit, and in fact takes rank as the authoritative survey of the climate of the continent. H. A. M.

GLACIAL GEOLOGY AND GEOGRAPHIC CONDITIONS OF THE Lower Mohawk Valley. A survey of the Amsterdam, Fonda, Gloversville, and Broadalbin Quadrangles. By A. P. BRIGHAM. (New York State Museum Bulletin, No. 280.) *Albany: The University of the State of New York* 1929. 9×6 *inches; 134 pages; illustrations and maps*

This exposition of the glaciology and geographical conditions in some 900 square miles of territory lying athwart the lower Mohawk Valley has two objects. Firstly, it is intended to set forth in quite considerable detail the results of the author's prolonged studies of the glacial distributions and glacial history of the area together with an outline of the influence of these factors in the human geography. Secondly, and rather as an undercurrent of ulterior motive, it attempts to guide and stimulate the teacher of the local geography of the area.

In some respects the double objective is hardly productive of happy results, for the body of the work is a closely argued discussion of the origin of the Adirondack and Mohawk glacial phenomena, and one may be permitted to question whether the reader who requires to be told that, in the case of a fault, "the geologist finds signs of the actual amount of 'throw' which are not obvious to the untrained reader," or who desires an explanation of "glacial striae" and "rock gravings" will be entirely at home in a perusal of the evidence for the thickness of the Mohawk glacier, or of such (undefined) terms as "isobase."

Rather more than two-thirds of the bulletin deals with the glaciology and forms a really valuable aid to understanding the physiography of a highly interesting area. The remainder is an avowedly skeletal account of the utilization of the land. Here it is difficult to appreciate just why the author feels that he has obtained absolution from the necessity of "a more symmetrical and detailed treatment" by substituting "geographic conditions" for geography in the title. Actually the scope of this section would have been conveyed better by the expression "some geographic influences in the Lower Mohawk Valley." The section is, on the whole, excellent alike in its clear exposition of the Mohawk as a passage way and in its vignettes of the relation of town-site, industrial location, and communications to the detail of the physical milieu. The treatment of soils and agriculture is the least satisfactory and complete, for while detailing soil variation in considerable detail there is an almost complete neglect of the influence of this variation upon land utilization.

The folding map of the glacial geology on a scale of 1 : 62,250 is a pleasing example of the technique of representing detailed superficial geology. H. A. M.

GRUNDRISS DER TROPISCHEN UND SUBTROPISCHEN BODENkunde. By P. VAGELER. *Berlin: Verlagsgesellschaft für Ackerbau* 1930. 9×6 *inches; 216 pages; illustrations. M.12.75*

Although this refreshingly unorthodox book by one of the foremost investigators of tropical soils is intended primarily for the practical planter and for the student, it contains a wealth of material of the greatest interest to the geographer. For not only does it revise a number of old-fashioned yet still almost universally accepted conceptions on soil formation in the tropics and sub-tropics which, in their new form, will undoubtedly have to be considered by the physical geographer; but it also sheds new light, from the point of view of Human Geography, on the complicated problems connected with the ever-increasing development of tropical new-lands by planters and settlers.

The text makes very good reading throughout, and even the technicalities of a highly complex and difficult science are rendered comparatively easy for the layman. There is a good index, and a small but well-chosen number of excellent photographs and two instructive soil profiles in colour form a welcome addition

(on p. 154 the reference to one of these should obviously read "Table II," and not "I," as printed).

In a short notice it is only possible to mention a few of the many geographically interesting conclusions which are of outstanding importance. Foremost among these is the emphasis laid on the fact that, although the same laws regarding the effect of the climatic factors on the weathering of a given rock formation hold good in the tropics and in temperate zones, the intensity of this effect, both as regards dimensions and time, is very much increased in the former. With average temperatures 10° to 20° centigrade higher, with, in parts, very much higher precipitation and mainly owing to the absence of the rest-period of winter, the author estimates an at least tenfold increase of the intensity of weathering, and concludes that thereby changes in the mineral composition of the soil-substance and their effects, recognizable in temperate climates only after long periods, must in the tropics show themselves, and must become of outstanding practical importance within a relatively short time. The exact knowledge of the mineral reserves thus becomes for tropical soils a factor hardly less, and in individual cases even more important for a correct soil valuation, than the usually accepted factors of actual physical and chemical conditions.

The prevailing lack of a careful preliminary soil analysis and the dangers inherent in the consequent wrong choice of land are made responsible—and justly in the reviewer's opinion—for a large percentage of the failures of tropical and sub-tropical agricultural enterprises, and it is a healthy sign of the progressive understanding of geographical controls to find that misleading slogan of the "inexhaustible tropical soils" definitely contradicted. This wealth, in Dr. Vageler's own words, "is only rarely found in Nature and then only after careful searching backed by the full experience of practice and theory." Nobody who on his own behalf or on that of his employers ventures into the difficult field of tropical agriculture, and nobody whose business it is to advise on, or to watch and study, from the general geographical or the more strictly economical point of view, the agricultural possibilities of our tropical "new-lands," can in future afford to neglect the extremely sound advice contained in the sixth chapter of this book, and more particularly in its first three or four pages. It is to be hoped that an English edition may soon be available and that every planter and every agricultural officer in our vast tropical and sub-tropical possessions will provide himself with a copy.

Space only permits of the bare mention of a few more points of geographical interest: there are some new and important statements in Chapters III and IV, where vegetation forms are discussed as contributors of organic substance to the soil, and the climatic factors are shown in their interdependence with topography and vegetation. The new and somewhat unorthodox definitions of savannah and steppe are to be welcomed. The even more unorthodox views on rain-forest soils should be very carefully digested and, where necessary, either confirmed or definitely disproved. The edaphic influences on the savannah "dry forests" which, especially in East Africa, cover such vast belts of potential "new-lands," are rightly emphasized. The very decisive influence of sheet-floods on soil conditions in the more arid or semi-arid tropics is fully brought out.

The observations on the automatic mechanical mixing of the heavy or cracking clays (first studied in the Soudan), whereby the whole soil material down to the level of the deepest cracks is kept in constant circulation, are most instructive; and the remarks on the low stability of the red colouring of tropical red earths very interesting. Although the novel treatment of the most important problems of lateritization and of the part played by humus in tropical soils would appear to the reviewer to possess the greatest value not only to the soil expert, but even

more so to the geologist and palaeoclimatologist, he lacks sufficient knowledge to make any remarks on this subject.

The tropical and sub-tropical hardpans and crusts, such enticing objects for the geologist and geomorphologist and so dangerous to the agriculturist, find proper mention, although Professor Woolnough's captivating Australian studies of these structures do not seem to have been consulted. It is a pity that the book does not contribute new knowledge on the as yet unsolved problem of the formation of "terra rossa" on limestones. C. G.

ECONOMIC AND HISTORICAL GEOGRAPHY

GALLIENI. By GUILLAUME GRANDIDIER. (Les Grandes Figures Coloniales, 3.) *Paris: Librairie Plon* 1931. 8×5 *inches; 257 pages; illustrations. 15 fr*

The career of Gallieni displays many similarities to that of Kitchener: both took part in the Franco-Prussian War, the greater part of their life-work was spent in colonial war and administration, and both were called to high office in the crisis of 1914. M. Grandidier gives a compact and eloquent eulogy of Gallieni's work in the colonies, though the personal side is rather neglected, illustrated by a number of manuscripts which have lately come into the possession of the Paris Geographical Society. These relate mainly to the tortuous and painful negotiations between Gallieni and the Sultan Amadu of Segu, by which French suzerainty was established over the Niger above Timbuktu. Later, his characteristic tenacity, farsightedness, and readiness to disregard superior orders when necessary, were rewarded by the conquest of Madagascar. Gallieni's final task was as Military Governor of Paris in 1914. Though it may not be possible to give him sole credit for the preparations leading up to the victory on the Marne, his actions were undoubtedly a contributory factor of great importance, and he proudly maintained his pledge to defend Paris: "Ce mandat, je le remplirai jusqu' au bout." G. R. C.

MARKETS OF LONDON. By CUTHBERT MAUGHAM. *London: Sir Isaac Pitman & Sons* 1931. 9×6 *inches;* x+208 *pages. 6s*

The great markets of London still occupy a position of world pre-eminence, based on the unique character of London itself as a population, administrative, financial, and port centre. To these factors must be added those accruing from the whole historical trend of British trade and overseas development. It has thus resulted that not only is Great Britain supplied with foodstuffs and raw materials to a disproportionate extent through the London Markets, but these same markets, though unhappily to a lessening degree, are used by buyers from all over the world. In the present work the author has avoided any account of the historical development of the markets and almost all mention of their financial operations; and in the limited space at his disposal he does little more than indicate, in each case, the position of the market and the commodities with which it deals.

The work is readable, and, within the limits which the author has set himself, informative. It is admittedly not written for the specialist in any particular group of commodities, and we think it would have been of greater interest to the general reader, and certainly to the geographer, had greater attention been paid to the causes which have affected the siting of the greater markets of London, as well as to the problems in lay-out and town planning which many of them present to-day. LL. R. J.

THE MONTHLY RECORD

THE SOCIETY: CHANGES IN THE BYE-LAWS RELATING TO ENTRANCE FEES ON ELECTION

A notice to Fellows issued with the December *Journal* announced that the Council had taken into consideration suggestions for certain modifications in the Bye-Laws to meet present circumstances: to allow payment of Entrance Fee spread over a term of years: to reduce it for those who wish to join the Society quite early in life: to remit it for wives or husbands of Fellows who wish to obtain the full privileges of Fellowship in place of attending the meetings of the Society as visitors; and to remit it also for widows or widowers of Fellows recently deceased who wish to maintain their interest in the Society's work. They therefore proposed amendments to Bye-Laws Chapter V, § 1, to give effect to these changes, and called a Special General Meeting for Thursday January 14 to consider and, if approved, adopt them.

These amendments were accepted by the vote of the Special General Meeting, and the revised Bye-Laws are printed on p. iii of the cover. They provide that a newly elected Fellow may, if he so desire, spread his Entrance Fee over a term of years by paying one pound per year for six years instead of five pounds in one sum on election; that a Fellow elected under the age of twenty-three years shall pay two pounds as Entrance Fee instead of five, or an additional one pound per year for three years; and that wives or husbands of Fellows, and widows or widowers of Fellows elected within twelve months of the decease of husband or wife shall pay no entrance fee.

By a Standing Order of Council a candidate was not considered eligible unless he had attained the age of twenty-one years or held a Commission in His Majesty's Forces. To this the Council resolved on November 30 to add the following words: ". . . or unless he is a matriculated student of a University of the United Kingdom or the Self-Governing British Dominions."

THE SHACKLETON MEMORIAL

The heroic statue in bronze, modelled by Mr. Charles Jagger, A.R.A., for the Shackleton Memorial Committee, was unveiled by the Marquess of Zetland, Chairman of the Committee, on the afternoon of Saturday January 9, the twenty-third anniversary of the day when Shackleton reached his farthest south in latitude 88° 23′. Before the ceremony of unveiling Lord Zetland and Dr. Hugh Robert Mill delivered commemorative addresses in the Hall before a large company which included many who had sailed with Shackleton; and at their conclusion the President of the Society expressed to the Committee the gratitude of Lady Shackleton and her family, and accepted the custody of the memorial. A photograph of the statue and the text of the addresses will be published in the *Journal* for March.

When the Committee some years ago asked the Council to grant a site for the memorial they had in mind a place in the forecourt of the original house. The scheme for building the Hall was then at a very early stage: but it was evident that to exclude the noise of a busy corner the outer walls of the Hall must be windowless, and would be suitably adorned by memorial statues. On the instructions of the Council Mr. George Kennedy therefore provided in his plan a stone niche in each of the two outer walls, and that on the eastern wall, overlooking Exhibition Road, was proposed for the Shackleton Memorial. The Committee thereupon invited Mr. Jagger to accept the commission, and his sketch model was very soon approved by the Council and exhibited in the Society's House.

Those who had at a later stage the privilege of seeing the clay in the sculptor's studio were able to admire his treatment of the picturesque sledging kit and his skill in finding a convention for representing fur in bronze. When the completed statue was unveiled the full measure of his success was apparent. The figure is monumental and at the same time an excellent portrait, as those who had sledged with Shackleton and knew him well were able to assure the sculptor, who had never seen him. The heroic figure is well placed to catch the sidelight of the morning sun in the niche which was destined for it from the first sketch-plans of the Hall. The vacant sister niche facing Kensington Gore awaits some other British explorer of fame and affectionate regard great enough to secure him a National Memorial.

FILMS OF GEOGRAPHICAL INTEREST

There are several reasons why films of the "Cine-Kodak" gauge, of 16 mm., are now so largely used by travellers. The camera and the film are relatively small, light, and inexpensive: and, most important, the film being on a non-inflammable base, the undeveloped negative may be sent home readily through the post, for development and printing. But it has been considered impossible to project this small film into a large picture suitable for a Hall such as ours. A few months ago every one said that it had not been done, and the makers of projection apparatus said that it could not be done. Nevertheless there was evidently no optical impossibility: the problem was to condense enough light upon the small 16 mm. gate without at the same time concentrating enough heat to destroy the film during its brief passage, and to obtain a lens of the necessary long focus. An obvious experiment was to mount the projector of the 16-mm. film in front of the lantern belonging to the new standard projector by Ross recently installed in the Society's projection room. After some discussion on details Messrs. Newton undertook to do this, and on the occasion when the Hall was lent to the Royal Central Asian Society, Mr. C. P. Skrine's 16-mm. film was actually projected into a 12- or 13-foot picture. The result was passable, but the light not really sufficient. After a few experiments it was decided to order a lens of 3 inches focal length to throw a picture 9 feet wide from the 16-mm. film at the operating distance of 70 feet, and this lens is now in use. The Ross machine has been adapted so that its own projector may be replaced by the smaller projector in two or three minutes. The films from the Greenland Expedition shown on December 13 and 18 were partly standard 35-mm. film and partly 16 mm. No one would pretend that the latter were as good as the former, but every one would agree that they were uncommonly good, and any traveller proposing to read a paper to the Society may undertake with confidence to illustrate it with the miniature film if he so desires.

We shall doubtless have more and more kinematograph films at our meetings, and it will be interesting to see how they are most successfully employed. Present experience shows that to use film for long at a time tends to destroy any serious value in the paper. It is impossible for a speaker to keep pace with the film and say what he wants to say. On the other hand, he may very usefully show film for a few minutes at a time, to illustrate a special point, or even to rest himself or divert his audience. If he has enough film for a long show it is probably better to use a little at the lecture proper and to show the whole a week or two later.

Much has been said of late on the use of the film in geographical education, but films made especially to this end have not always proved successful. Teachers of geography would probably find it useful both to see such films projected and to have opportunity to discuss with their makers how they might be improved.

It is proposed therefore that the new exhibitions of Geographical Films

announced in the programme for the session shall from time to time include films made for instruction, and that opportunity shall be given for criticism and discussion. Thus in the programme for Monday February 1, after Mrs. Murray Chapman has shown her film Lapland in Winter, two films of Granada and Seville will be shown by Mr. Radley on behalf of Visual Education, Ltd., and he will welcome comment upon them.

Since the establishment of these film exhibitions the Secretary has been gratified to learn how much material there is in the country suitable for exhibition to the Society. And there is doubtless very much more of which he has not yet heard. He will be obliged to any travellers who may have film which would interest the Society if they will acquaint him with it.

CHRISTMAS LECTURES TO YOUNG PEOPLE

The Christmas Lectures were given on January 4 and 8 and were well attended. That on the 4th, under the title of "South and East," was given by the President, who took his audience on a pleasant and varied cruise down the Atlantic coast of Spain, into the Mediterranean, and through the Red Sea to Aden. The first, and one of the most interesting, of his halting places was Santiago de Compostella, whose lovely cathedral was shown on the screen to the accompaniment of a judicious mixture of the legends and history of the place. At Gibraltar there was some more history, but Malta tipped the balance back in favour of legend, for here the President told one of his favourite ghost stories. There were some good slides of Mount Athos and its monasteries, and of Constantinople; and a short account of the Suez Canal and Mecca completed a very enjoyable trip.

On the 8th Mrs. Murray Chapman gave an entertaining account of a journey "Through Lapland in Winter with Sledge and Reindeer," which she undertook in the early months of 1931. From Bossekop on the Altenfjord, lat. 70°, she travelled by sledge south-eastwards over the mountains to Karasjok, being held up on the way at a lonely hut by an unusually severe blizzard. She was at Karasjok at the time of the Lapp fair and also was lucky to witness a Lapp wedding. Here she learnt how to drive reindeer without frequently upsetting the sledge. All these things were attractively illustrated by slide and film and also by a few photographs of her own watercolours which brought out among other things the brilliant costumes of the Lapps and the beauty of the aurora borealis. From Karasjok she drove south-westwards by Kautokeino and across a narrow strip of Finland to Karesuando in Swedish Lapland and thence by Soppero and Vittangi to Kiruna, whence the railway took her back to the Norwegian coast at Narvik. The Karasjok–Kautokeino region had been visited in the summer of 1930 by the Oxford University Exploration Club, and an account of that expedition was given in *G.J.*, vol. 79, pp. 44–48.

GLACIAL FEATURES OF WHARFEDALE

For some years Dr. Raistrick has made a close study of the glaciation of Northern England, and his results have been published in the *Proceedings of the Yorkshire Geological Society* and elsewhere. Two of his papers—one dealing with Borrowdale, the other with Wensleydale, Swaledale, and adjacent parts of the Pennines—were noticed in the *Journal* for July 1896 and June 1927 respectively. His latest contribution, in the above-named *Proceedings*, 1931, Part 1, is concerned with Wharfedale. He begins with a brief sketch of the topography and structure of the valley and its tributaries, the Skirfare and Washburn. In its upper part the Wharfe valley is cut in the Yoredale Series of the Carboniferous, while the central and lower parts (down to Wetherley) are in the Millstone Grit, through which there is a gorge-like cut between Earls Seat and Barden Moor.

Drift deposits are found over the whole area, but rather of a sandy nature than true boulder clay. In the upper valley the included pebbles are mostly of the local Carboniferous rock, though a small percentage of a green Silurian grit is seen at one spot. Lower down the drift carries a large percentage of Millstone grit. At the maximum glaciation the fells at the head of the dale were dominated by a large ice-cap which sent branches south-west and south to the Ribble and south-east to the Aire and Wharfe, the ice in the several valleys being in close mutual contact, while in the lower Wharfe valley it pressed against the edge of the Vale of York ice. In Wharfedale however the streams never diverged much from the general direction of the valley, being confluent valley glaciers rather than ice-sheets.

During the retreat of the ice many lakes and lateral drainage channels were formed, a parallel series being often traceable at different levels corresponding to successive stages in the retreat. Dr. Raistrick traces their courses in great detail, some of them cutting across the existing water-partings and taking the drainage from one valley to another. A series of barriers across the Wharfe valley represent the terminal moraine at successive periods of the retreat of the ice, lakes being formed behind them, now represented by flats which are a marked feature of the dale topography. The lakes were mostly drained by a cut through the morainic material, though in one or two cases the overflow eroded a channel in the solid rocks at the end of the barrier. While the lakes existed tributary streams built up large deltas, in which the old flat-topped lake delta can often be distinguished from a steeper dry delta of the present fell-side stream. Many of these deltas are now village sites. Linton village is built on a lateral moraine of the Wharfe glacier which closed the Linton valley and impounded a lake only recently drained.

CLOUDBURSTS IN WESTMORELAND

On 18 June 1930 an outbreak of violent thunderstorms occurred in different parts of the country, and there developed over Stainmore Forest, at the southern end of the Cross Fell range, a storm, or succession of storms, of that formidable "cloudburst" type which is comparatively common on the high fells of the North of England. According to Mr. F. Hudleston, M.Inst.C.E., a local engineer, who describes the effects in 'British Rainfall 1930,' recently published, some five holes within a range of 4 miles were dug into the peat on, or close to, the summit of Knipe Moor, which forms the watershed between the Eden and Tees near the Westmoreland and Yorkshire boundary. Mr. Hudleston made a careful survey of the scars four months after the storm, and describes the holes as varying in shape from the roughly circular to the elliptic, and as having in one or two cases definite furrows leading to the beck channels. The largest hole was as much as 4 acres in area and many feet deep, the peat being entirely removed and the boulder clay beneath exposed. From this hole a filthy black solution went down the river Eden, choking many thousands of trout as far down as Appleby, some 16 miles below the spot where it was dug out on the moor. Many dead sheep and grouse were found in the vicinity of the holes, and doubt is expressed whether any human being would have lived to tell the tale had he been near one of them at the time it was formed. The nearest witness of the cloudbursts, a gamekeeper, refers to an intensely black cloud which gathered over Knipe Moor discharging "terrific lightning" and a "solid fall of water," covering Shott Moss till it looked like a sheet of water; but he does not appear to have seen the actual downpours which made any of the scars. Mr. Hudleston concludes that the holes were dug by travelling jets or spouts of water due to the sudden collapse of a heavily charged cloud driven upwards by the steep face of the hillside, but considers that the terrific lightning also played its part in the work.

On the actual appearance of cloudbursts of this sort the last word has not been said. Local reports are always strongly insistent that the rain falls as a solid spout and not in drops, contrary to meteorological theory, which nevertheless admits that vast quantities of water are often held up by powerful convection currents and suddenly released.

EUROPEAN MOUNTAIN POPULATIONS

A good deal has been written of late, in France, Switzerland, Germany, and Italy, on the economic conditions of mountain dwellers, and on the decline of population which has been a marked tendency within the past half-century or more. A general view of the question has been given by Mr. R. Peattie, of the Ohio State University, on the basis of such scattered literature as exists, in the *Annales de Géographie* for July 1931. Statistics show that on the whole mountain populations tended to increase down to about 1850, but that the reverse process has since been in force. The earlier tendency was in part due to the refuge afforded by the mountains to the weaker elements among the plain-dwellers, but there came a time when the limited resources of the mountains no longer sufficed to support even the natural increase. The resulting exodus was helped by the improvement in the means of communication between the mountains and the outer world, which in many cases hardly existed at all till quite recent times. The attraction exercised by the cities, or by the newly opened lands in America and elsewhere, could thus make itself effective, and some communes in the French Alps have lost 40 per cent. and more of their population. On the other hand the same cause may have occasionally had the opposite effect by encouraging the growth of local industries. With the decrease in the number of workers agriculture has more and more given place to pastoral pursuits, and the upper limit of arable lands has fallen considerably. The introduction of improved methods of cultivation has however increased the yield in the areas remaining under the plough. A sinister factor has been the reckless destruction of forests, with all the ills that it carries in its train. As regards the distribution of the population, it is broadly true that this diminishes with altitude, but there are many exceptions, as shown by the statistics for Corsica. In many Alpine valleys, in addition to the concentration on the bottoms, there is a second well-peopled zone higher up, where villages are grouped on the middle slopes exposed to the sun. The upper limits are imposed rather by economic than physiological conditions.

AN ATLANTIC–MEDITERRANEAN SHIP CANAL

The project of a canal for ocean-going vessels between Narbonne and Bordeaux —the "Canal des Deux Mers"—has been advanced many times during the last fifty years. Its advocacy has again been resumed by the newly formed "Union maritime du Sud-ouest," whose aims are set out by M. Hector Ghilini, in *L'Illustration*, 12 December 1931. The idea had been anticipated by the "Canal du Midi," opened in 1681, and the "Canal lateral de la Garonne" in 1856, but these are of course not up to modern requirements, and progress along them is hampered by 188 locks and 331 bridges. The projected canal would follow practically the same course, from Narbonne to Toulouse, and thence down the valley of the Garonne to Bordeaux, with a branch to Arcachon. Its length would be 453 km., with a surface width of 150 metres, and a depth of 13·5 metres. The bed would mostly lie through alluvial and other easily removable soils, and one-tenth of the cubic content alone would require to be blasted. It is calculated that the excavation could be completed in five years. The works include 14 locks, electrically operated, with a rise varying from 20 to 22·5 metres, and constructed to deal with several sizes of vessels.

The point around which controversy has raged is whether there would be an economic return on the outlay. This canal is regarded by its advocates as part of a greater scheme for restoring the economic prosperity of Southern France, and as a counter-balance to the present dangerous concentration around Paris. It is anticipated that the diversion of traffic through this canal will stimulate the growth of industries, which would also derive power from the proposed hydro-electric installations. Provisions are also to be made for irrigating large areas in the neighbourhood. It is hoped to supply a system of communications which would enable the hitherto untouched resources of the south to be tapped. All these developments would check the depopulation at present afflicting the region.

It is obvious however that these are secondary considerations only, and that the main factors are the initial cost, and the extent to which the canal would be used. The cost is estimated at 15 milliards of francs, and the promoters estimate an annual gross income of 1 milliard, based upon the passage of 20,000 vessels per annum, of an average burden of 5000 tons. The canal would be traversed in twenty-four hours and would considerably shorten the route from Western Europe to the Mediterranean, *e.g.* from London to Marseille by 1856 km., Liverpool–Genoa by 1765 km., and Oslo–Port Said by 1349 km. It is claimed that the recent experience of other countries remove all doubts as to the success of such a canal. It has up to the present met with the opposition of the Ministry of Public Works. From a naval point of view however it has received considerable support. A demand for the concession has been deposited with the Ministry.

RAILWAYS IN EUROPE, 1830–1848

The development of the railway system of Europe between the years 1830 and 1848 is briefly described by L.-M. Jouffroy in *Annales de Géographie*, September 1931. This period marked the greatest advance in construction, and the aim of the writer is to trace the varying effects upon contemporary thought in each country. The year 1848 is chosen as a terminus, since it marked the close of the initial effort, the fruits of which were not yet gathered. It also marked, as in other spheres of activity, a severe economic crisis, itself the product of political unrest. In Belgium, the plan of construction was especially methodical; the main lines of the national system were completed between 1835 and 1843, at an expenditure approximately equal to one-third of the annual income of the state. From a national view-point she had then reached a stage not to be achieved by France until ten years later. Further construction was then handed over to private enterprise. Of great economic importance was the linking of Ostend and Antwerp with the Rhine, which challenged the supremacy of Rotterdam; in the south however the interior was cut off from natural outlets in Dunkerque, Boulogne, Havre, and elsewhere. Further stimulus came from the opening in 1848, partly by water, partly by rail, of the route to the Adriatic and to the Black Sea. In the Germanic Confederation, the early lines appear extremely haphazard, the victims of the rivalries of petty principalities, but the growth of the vast tentacle of lines gave evidence of a coherent plan. Its principal feature was the line from Aix-la-Chapelle in the north-west, with one small break, to Cilli on the route to Trieste in the south-east; with its radiating lines it bound firmly together all the regions in the political orbit of Prussia. Its route may at first sight appear unusual, but if it is related to the river system, which provided north–south communication, it will be seen that it constitutes a transverse artery, crossing all the five great rivers. Where the rivers were unsatisfactory, they were supplemented by parallel lines, for instance, the Rhine from Mainz to Basel. A similar development may be traced in Holland.

In France the course of development was different, since the rivers do not

favour rapid passenger traffic. If economic requirements alone had been considered, two main routes would have been projected: a north–south line linking Boulogne, the industrial areas around Laon, Rheims, Châtillon-sur-Seine, Lyon, and Marseille; the second, from Strasbourg to Châlons-sur-Marne, Amiens, Havre. These would have supplemented the canal system, but the routes actually constructed competed with the canals, even with those recently built, and the whole railway system was made to radiate from Paris, a legacy of the traditional French policy. By 1848 there were no traces of the Strasbourg or Mediterranean lines; the absence of the first was handicapping Havre in competition with Antwerp, and that of the second was sending Central European trade to Trieste instead of Marseille. By 1851 more than forty hours were saved on the journey from the East to London by travelling *via* Trieste rather than Marseille. Though France lost the advantages of a well-designed system to Belgium and Germany, she led in the design and quality of equipment, and thus was able to achieve speeds unknown to other continental countries.

CORRESPONDENCE

KAMET

May I correct a detail in Mr. Holdsworth's interesting speech at the paper referring to Kamet read by Mr. Smythe? The "extraordinarily strong and capable" guide with whom I reached the 23,000-foot saddle at the foot of the final slope of Kamet in 1913 was the Savoyard Pierre Blanc, not Franz Lochmatter. The latter brilliant guide was associated with us in a previous high attempt on the other side of the mountain in 1912. Blanc was by no means as completely finished as I was; he persisted in the climb with two exhausted Bhotias for an hour after I gave out. However rush tactics had proved useless, as Mr. Holdsworth rightly points out.

C. F. MEADE

Pen-y-lan, Meifod, Montgomery. 10 *January* 1932.

No one who heard Mr. F. S. Smythe's paper on 2 November 1931, or who read it in the January issue of the *Geographical Journal*, could admire more than I do myself the pluck, enterprise, and endurance of his party. He does however make one statement which it is not easy to understand. In connection with the Gangotri Glacier he states: "The Gangotri Glacier, about 25 miles long, appears never to have been visited since an enterprising officer of 'The Company' trod its lower portion over a hundred years ago."

I have always been peculiarly attracted by the upper Bhagirathi valley, and spent two long periods of leave there in 1910 and 1911. In 1910 I ascended some way up the Gangotri Glacier, but was merely following what had become practically a tourist route. For I doubt if there is any major glacier near the Tibetan frontier in the Garhwal Himalaya which has been visited by Englishmen so frequently and so regularly as the Gangotri Glacier.

The two first on the scene were Captains Raper and Webb, who apparently reached it in 1807. Captain Hodgson and Lieutenant Herbert visited it ten years later. So far as I know the next account of this valley is to be found in General Markham's well-known 'Shooting in the Himalayas' (1848). General Markham accompanied "Shikari" Wilson, who migrated into Tehri-Garhwal about 1840 and built himself a fine bungalow near Gangotri, which is still in existence.

Here he lived for twenty-five or thirty years, and his account of the district is published in 'A Summer Ramble in the Himalayas' (1860). Wilson described the country with meticulous accuracy and gave a list of all the principal passes. He mentioned a very difficult one from the valley of the Bhagirathi into that of the Vishnu Ganga which had fallen into disuse since the inhabitants of British Garhwal gave up raiding the flocks and herds of Tehri-Garhwal. He also mentions a pass leading into the Bheling valley. I found that the inhabitants of the upper Bhagirathi valley knew of both these passes by tradition, but was assured that no living man had crossed them.

From about 1870 until the outbreak of the Great War the Gangotri valley was one of the regular shooting grounds for sportsmen starting from Mussoorie, and scores of expeditions to Gangotri Glacier were undertaken. Further, the whole of this valley and its glaciers as well as those of the Jadh Ganga and the Vishnu and Dhauli Gangas in British Garhwal, were surveyed geologically by that indefatigable traveller and geologist, Griesbach, in the early eighties.

I am no mountaineer, and would never lay claim to be an explorer. But I can claim a fairly intimate acquaintance with every single branch nullah of any size in the Bhagirathi valley north of the gorge through the main axis of the Himalayas. In the Jadh Ganga valley, too, I have worked up a good many of the tributary nullahs. And in every nullah I visited I was always filled with admiration at the wonderful accuracy of the old ¼-inch Survey Map (Indian Atlas Sheet 65). It was not until the Jadh–Ganga–Sutlej watershed was crossed and Tibetan territory definitely entered that the map became unreliable: and here it was represented only as a crude sketch with dotted lines.

G. BURRARD,
Major R.F.A. (Retired)

Willow Lodge, Hungerford, Berks. 14 *January* 1932.

MEETINGS: SESSION 1931–1932

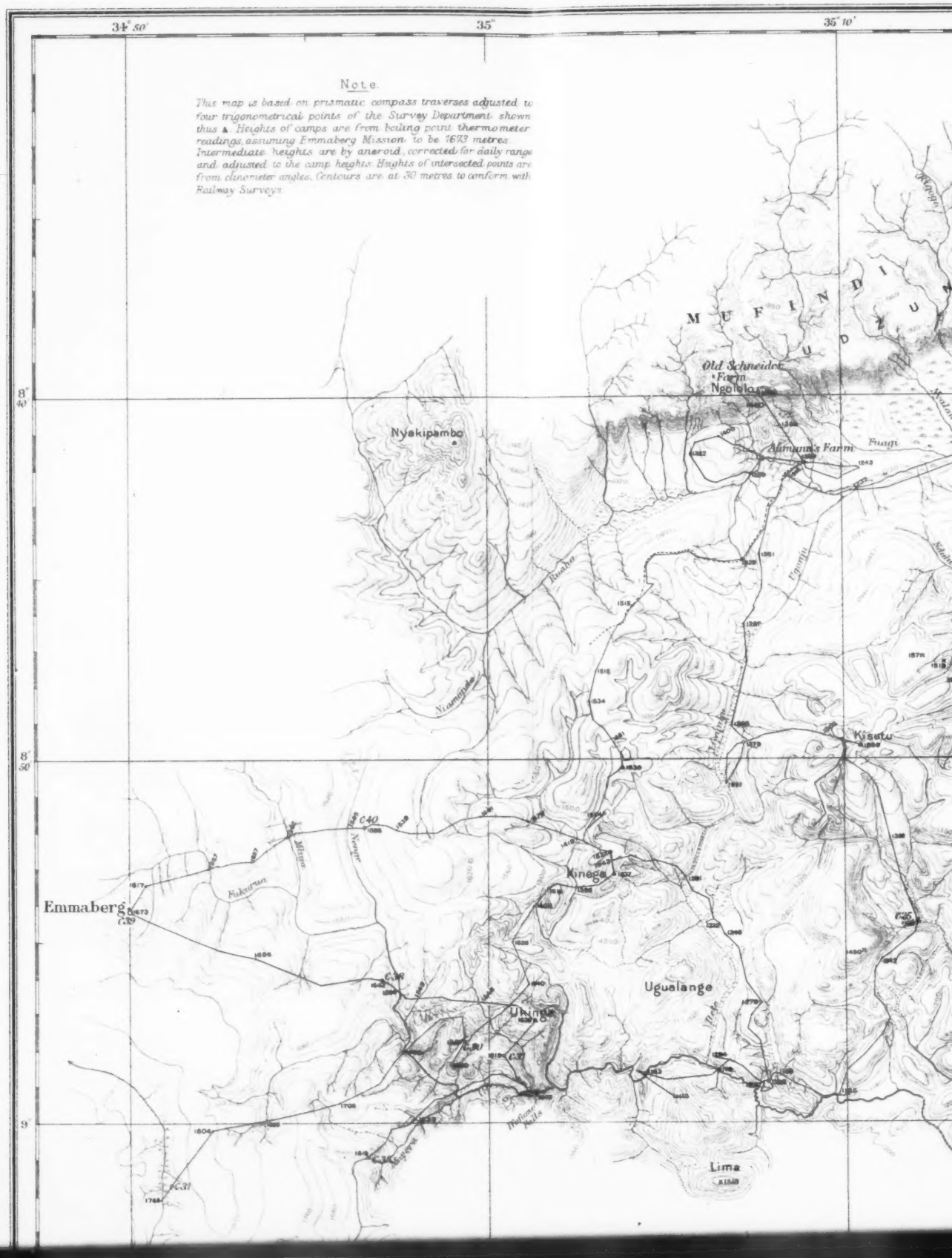
Fifth Evening Meeting, 11 January 1932. The President in the Chair

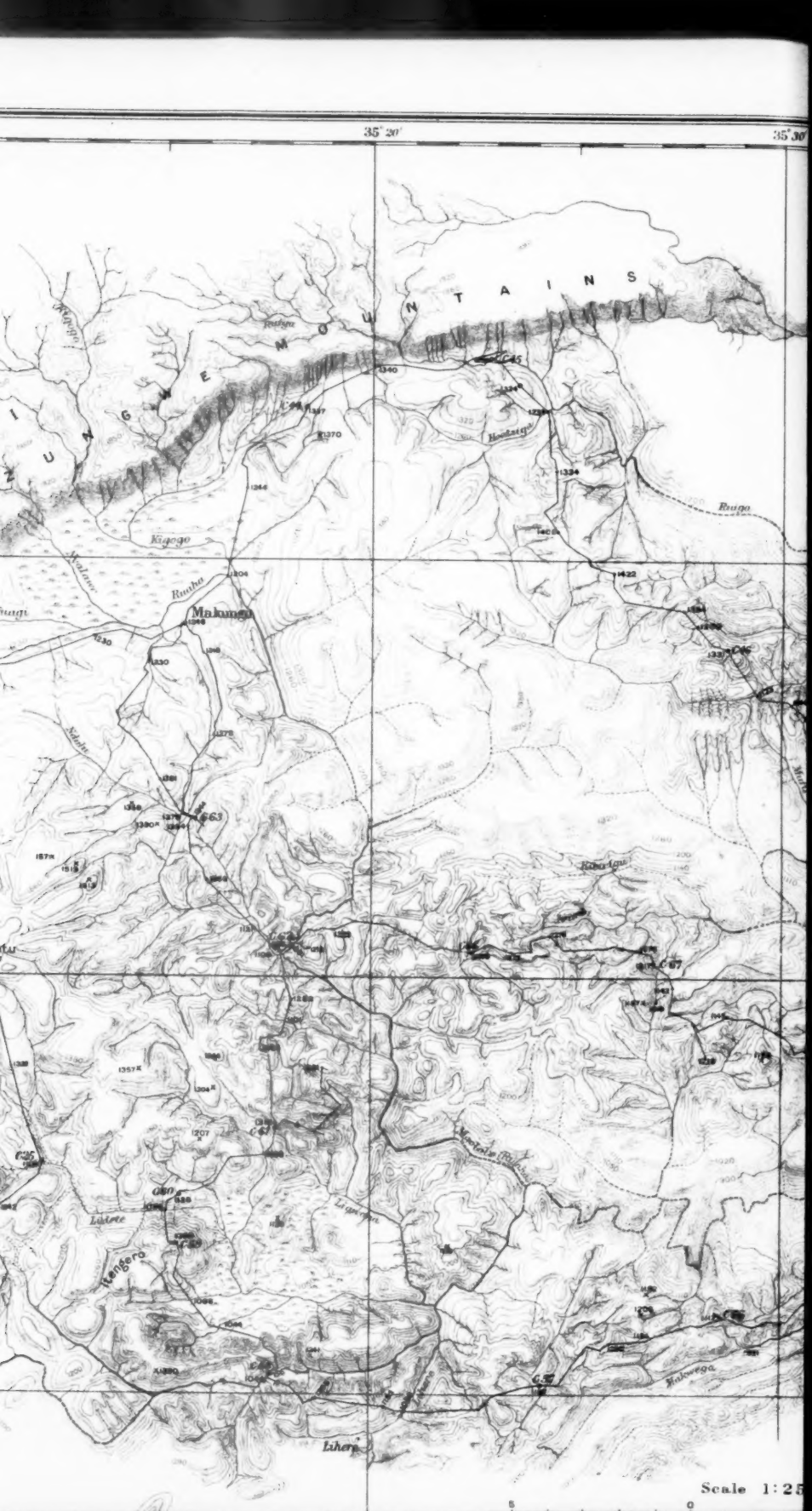
Elections: Vincent Astor; John H. Baker; Albert E. Ballard, M.A.; Miss Helen M. Beale; Captain W. E. Benson; W. S. H. Bernard; Ernest Briggs; William Stanley Brown; Captain S. C. D'Aubuz, R.A.; J. A. Dawes; Miss Katharine M. Courtauld; Walter J. Hall, M.A.; Miss J. Hampson; Miss M. Violet Hanbury Blackburn Holden, J.P.; A. Robert Hughes; Lt.-Commr. J. L. F. Hunt, R.N.; William Mair, F.C.S.; Major C. L. T. Parker, R.E.; Miss Kathleen M. Robinson; Brian B. F. Russell; A. J. Schwelm; Captain W. G. T. Summers; Miss Emma L. Sutton

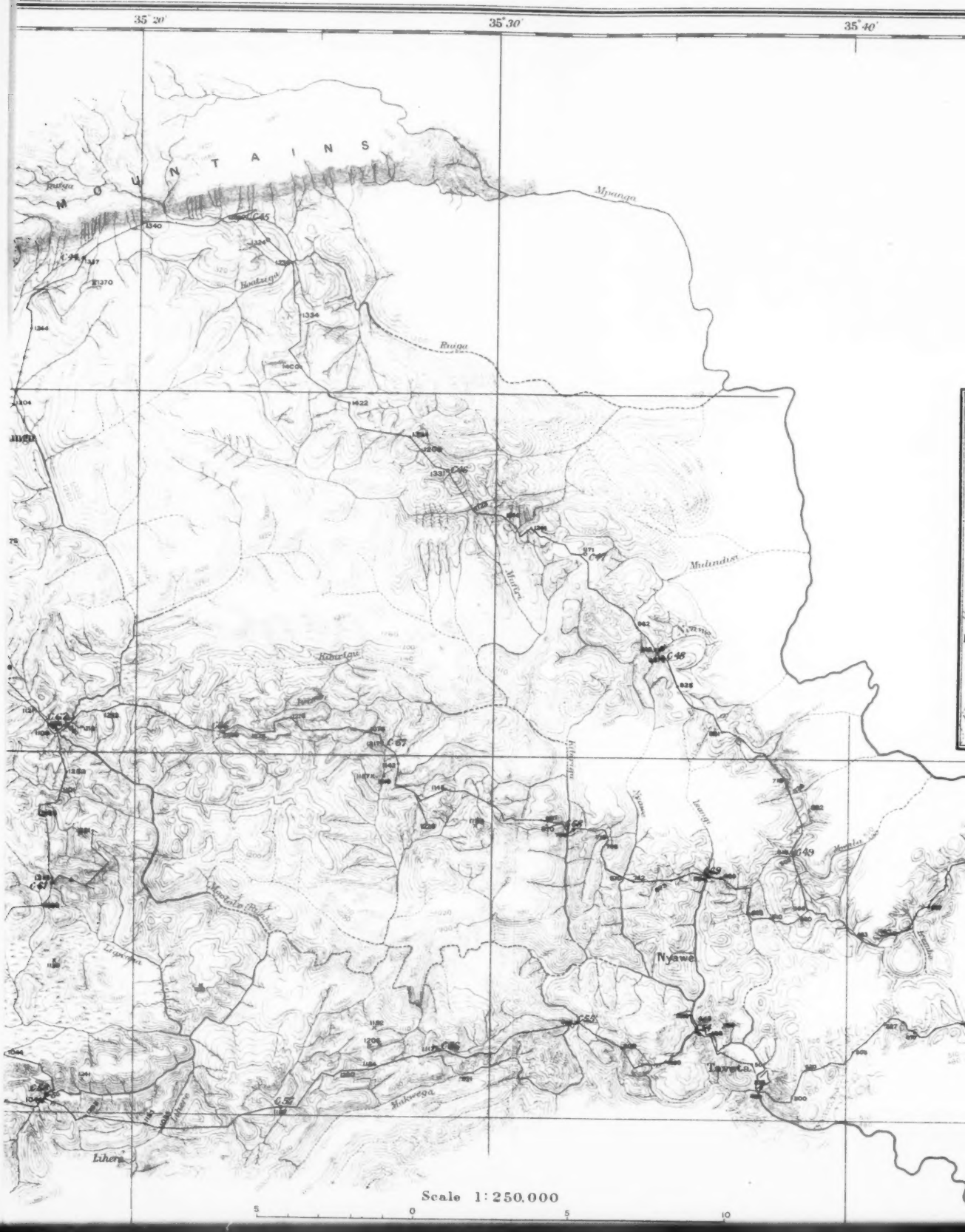
Paper: The Eastern Karakoram. By Professor Giotto Dainelli

Third Afternoon Meeting, 18 January 1932. The President in the Chair

Paper: The Lötschental: A Regional Study. By Professor J. F. Unstead


34° 50'
35°
35° 10'
8° 40'
8° 50'
9°
Note.
This map is based on prismatic compass traverses adjusted to four trigonometrical points of the Survey Department shown thus ▲. Heights of camps are from boiling point thermometer readings, assuming Emmaberg Mission to be 1673 metres. Intermediate heights are by aneroid, corrected for daily range and adjusted to the camp heights. Heights of intersected points are from clinometer angles. Contours are at 30 metres to conform with Railway Surveys.
M U F I N D I
Old Schneider's Farm
Ngololo
Nyakipambo
Ahmann's Farm
Fungi
Kisutu
Kinega
Emmaberg
Ugualange
Ukinga
Lima
Nianjinde
Fukuma
Mfuga
Nyuyu
Ruaha
Ngerengere
Mdandu
Mdandu falls
C.36
C.37
C.38
C.39
C.40

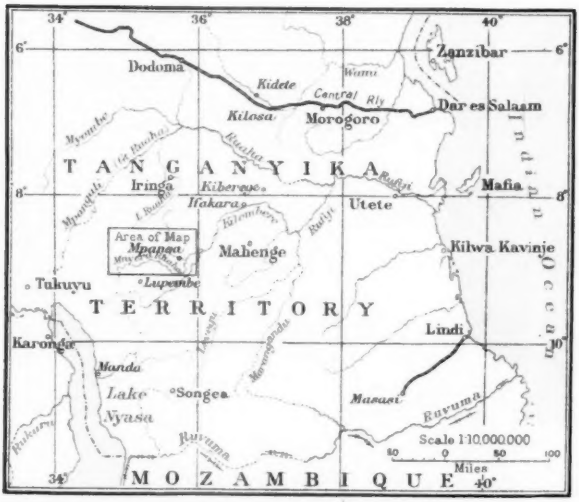

35° 20'
35° 30'
U L U N G E M O U N T A I N S
Kigogo
Mwakaua
Ruaha
Makungu
Ruaha
Kigogo
Mwakaua
Ruaha
Makungu
Ruaha

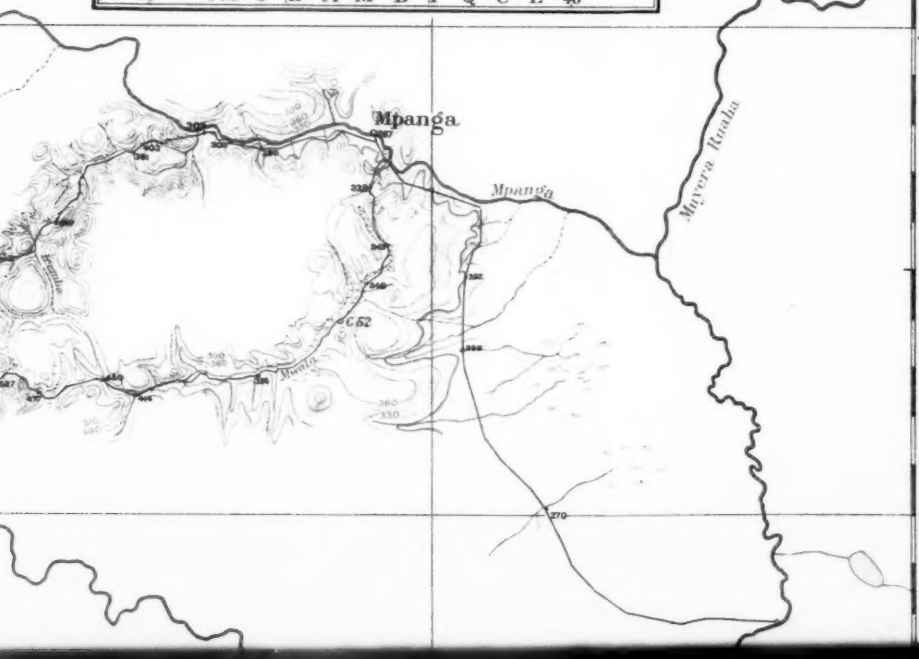

35° 20'
35° 30'
35° 40'
MOUNTAINS
Myanga
Ruaga
Mulindwa
Nyawe
Tayuta
Lihera
Scale 1:250,000
5
0
5
10

TANGANYIKA TERRITORY

Map of the Head Waters of the MNYERA RUAHA and neighbourhood from a survey by M. A. UNWIN HEATHCOTE

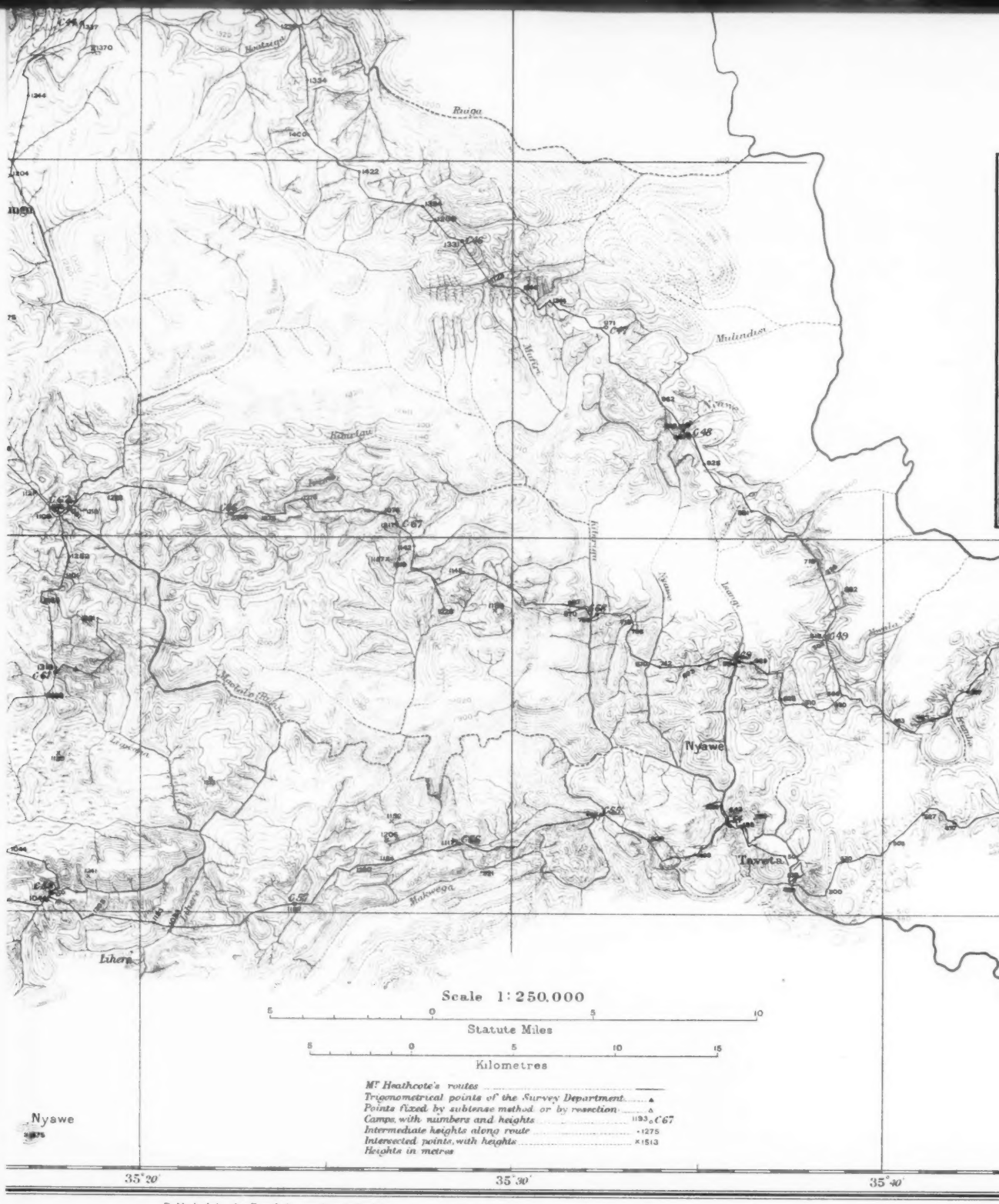
May-October 1930





Nyakipambo
Old Schweidel's Farm
Ngololo
Mamman's Farm
Bugi
Ruaha
Ugonju
Kisutu
Kinega
Emmaberg
Fukuma
Ugualange
Ukinga
Lima
C.40
C.36
C.37
C.31
C.35
8° 40'
8° 50'
9°
34° 50'
35°
35° 10'

Published by the Royal Geographical Society



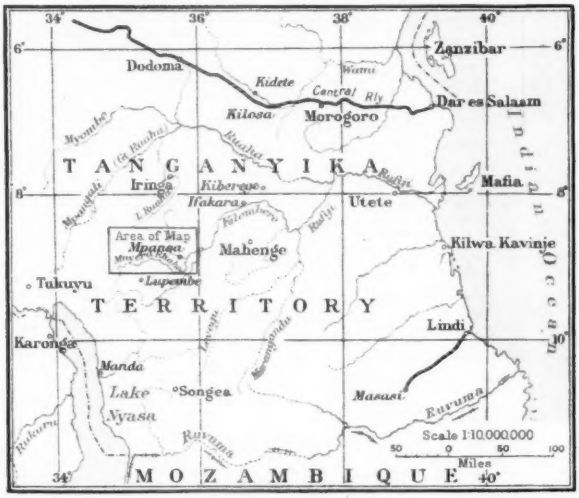
Published by the Royal Geographical Society

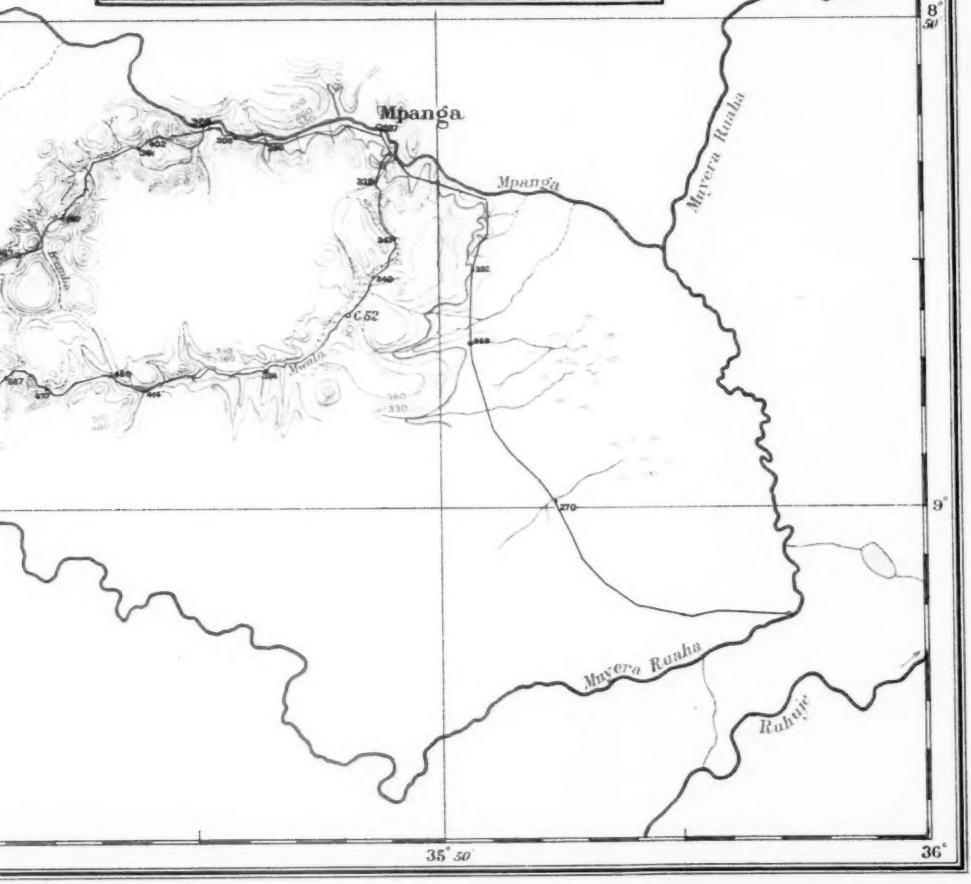
from a survey

by

M. A. UNWIN HEATHCOTE

May-October 1930





MNYERA RUAHA

Heathcote